LONDON WATER SUPPLY

BY

COLONEL SIR FRANCIS BOLTON, C.E.

To Sir A Clark Bart. M D &c &c

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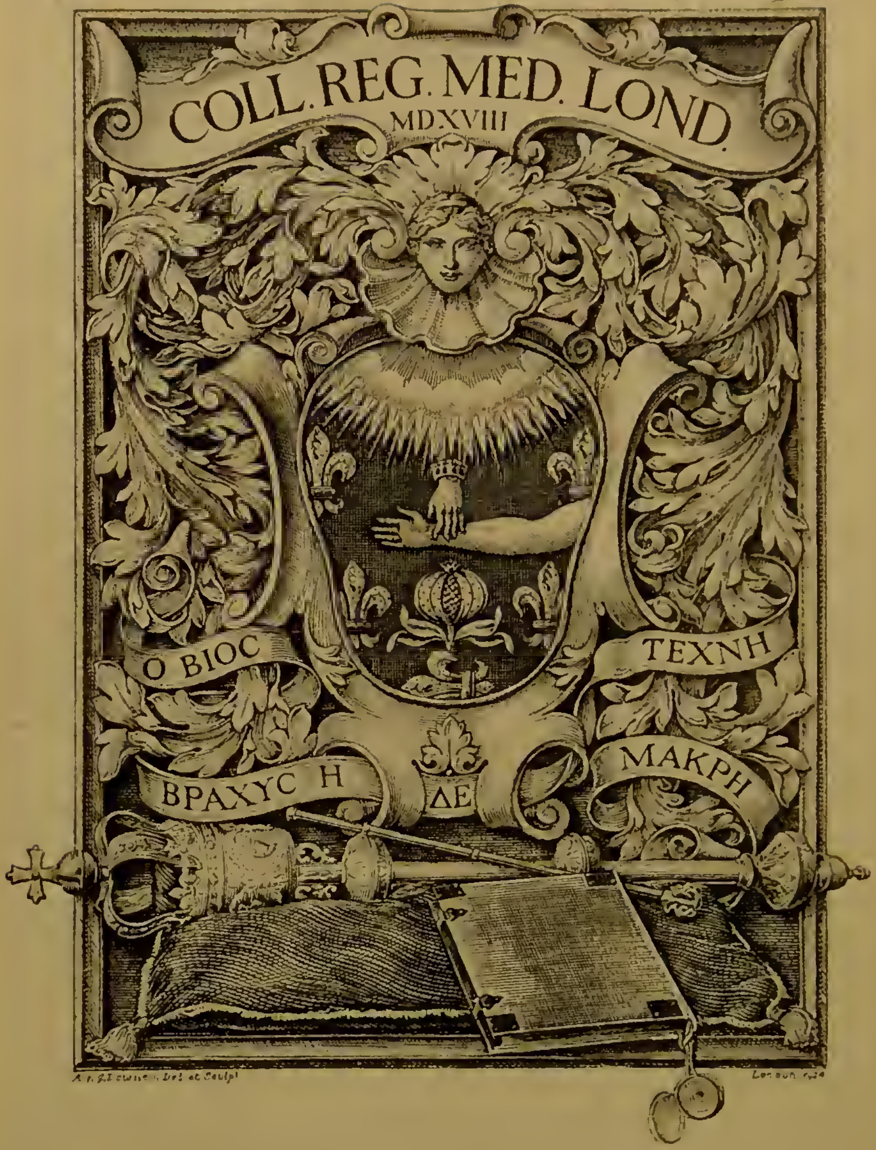

International Health Exhibition,
LONDON, 1884.

LONDON WATER SUPPLY.

BY

COLONEL SIR FRANCIS BOLTON, C.E.,
WATER EXAMINER "METROPOLIS WATER ACT, 1871."

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PREFATORY NOTICE.

The Author desires to express his cordial acknowledgments to the Engineers and Secretaries of the Metropolitan Water Companies for their important contributions in aid of the compilation of this book, and also to another member of the Sub-Committee, appointed in connection with the London Water Supply Exhibit at the International Health Exhibition, 1884, his friend Mr. Philip A. Scratchley, M.A., Oxon, for invaluable assistance in digesting, arranging, and revising the whole of the matter for press.

The Maps which appear in these pages were prepared from information kindly furnished by the Engineers.

The Author ventures to hope that this publication will be found of use in meeting an existing want, viz., a treatise on the System of the Metropolitan Water Supply ; a subject of which the vast majority of water-consumers (in other words, of the public at large) have but little knowledge.

The following pages are designed to give a concise description of How London is supplied with

Water; the modes of collection, storage, and distribution; the rates authorized to be levied; the History and Description of the Water Companies, their financial and legal position, and how they are controlled; together with suggestions respecting water-fittings in houses, and the official Regulations concerning the same. In short, the work is intended to convey information useful as well to Shareholders in the Water Companies as to Householders generally, and to serve as a text-book on the subject of London Water Supply, or (if the term be not too ambitious) as a Water-Consumers' *Vade Mecum.*

In a publication abounding, as this does, in figures and statistics, errors are specially apt to creep in, notwithstanding that the greatest care has been exercised to secure strict accuracy. Should any mistakes, therefore, be met with, the Author trusts they will be regarded with a lenient eye, and he will be greatly obliged by their being pointed out to him.

4, *The Sanctuary, Westminster,*
1884.

LONDON WATER SUPPLY.

PART I.

GENERAL INTRODUCTION.

CHAPTER I.—NOTES ON WATER SUPPLY.

1. SOURCES OF SUPPLY.—The sources whence a supply of water suitable to the requirements of a town or district may be obtained, can be classed generally under the three following heads, viz.—(*a*) Rivers, (*b*) Lakes, and (*c*) Wells. As water is one of the chief necessaries of life, every town, however small, must have some water supply; and the position and size of the town will probably not leave much choice in the selection of the source from which this supply is to be taken; but should any alternative exist, it is only by a careful consideration and comparison of the quality and quantity to be derived from the sources available, as well as of the expense of distributing the supply from each, that a satisfactory conclusion can be arrived at.

(*a*) *Rivers.*—This source may be taken to include all running waters, such as springs, streams, &c.

The ordinary flow of rivers is due to springs or other underground drainage, and it is only in times of flood or constant rain that surface waters find their way into the channel. In many rivers the fall is sufficiently great to enable the supply to be obtained by gravitation, by going some distance above the town. When this is not the case, pumping stations have generally to be provided. At the same time the character of most rivers will generally require some means to be adopted for the purification of the water.

(*b*) *Lakes.*—Under this head are included artificial reservoirs as well as natural lakes. Both are fed by streams, or by those porous soils which, acting like a sponge, serve to retain the rain until it is drained out by channels cut through them. In hilly districts the daily flow of small streams, fed chiefly by rains, is seldom sufficient for any large supply. It is therefore usual to store the water falling during the rainy season in large reservoirs, formed by throwing a dam of earthwork or masonry across a valley, thus constituting a large artificial lake.

If the gathering ground is favourable, and free from cultivation and animal contamination, water of great purity and extreme softness is obtained.

(*c*) *Wells* constitute the remaining source of supply, by sinking which water is obtained from the water-bearing strata below the surface. It need scarcely be said that well-water varies very much in quality, containing generally a large proportion of the various salts existing in the strata from which it is drawn. Many wells yield large supplies, 2,000,000 gallons per diem being not uncommon. In some wells the water rises above the surface, as at Bourne, in Lincolnshire, where there is a well 92 feet deep, yielding 567,000 gallons a day at an elevation of 39 ft. 9 in. above the ground, thus supplying the town by natural pressure. (See *Transactions*, *Inst. C. E.*, *vol. lxxv.*)

2. MODES OF PURIFICATION.—Except from mountain streams, springs, and some wells and gathering grounds, water is seldom found of sufficient purity to be distributed for general consumption without some means of purification. These may generally be divided into mechanical and chemical. The usual mechanical process is filtration, by which water is allowed to slowly percolate through sand, or other porous material, the surfaces of which arrest the particles of dirt, &c., held in suspension by the water. In

case the water is discoloured, or contains much organic impurity, this mechanical process is usually supplemented by a chemical one, such as Spencer's process, in which spathose iron ore is used, or Bischoff's, where spongy iron is employed ; or if the body of water to be dealt with is small, then it may be purified by filtering through charcoal, or other suitable porous material. Hard water, where the hardness is due to the presence of carbonate of lime, may be softened by the process invented by Dr. Clark, which has been adopted to a considerable extent.

3. MODES OF DISTRIBUTION.—When the source of supply is at sufficient altitude, the water is led through an aqueduct to the town, where by means of branch pipes it is delivered into the houses for consumption. Where, however, the source is not thus favourably situated, it is necessary to raise the water to a sufficient elevation by means of pumps. These generally pump into service reservoirs close to the town, the water thence descending by its own gravity. Where no site is available for service reservoirs, it is necessary to pump directly into the houses. This entails a large excess of pumping power and extra mains, so that it is only adopted where there is no alternative. The service reservoirs, unless situated in a very pure atmosphere, should be covered. Indeed, this plan is always advisable, as the water is thereby not only preserved from the impurities of the atmosphere, but is protected from the frost of winter, and the heating and vivifying effects of the sun's rays in summer.

4. MODES OF SUPPLY.—The modes of supply may be broadly divided into "intermittent" and "constant," the former when the water is turned on at intervals for a short time, and the latter when the mains are always charged.

The advantages of the constant system are generally admitted. The water is delivered through the pipes direct from the reservoirs to the consumer ; whereas, by the intermittent mode, the water must be stored in cisterns, where it is in many cases exposed to contamination from the atmosphere, and from the decay of any organic substance that may find its way into such receptacles.

5. AVERAGE CONSUMPTION. — The quantity of water per head to be supplied to a town can only be determined by experience. The following table, prepared from figures given by Sir J. W. Bazalgette, C.B., shows the great difference that exists in the quantity of water supplied to different towns.

TABLE SHOWING CONSUMPTION OF WATER PER HEAD OF POPULATION.

	Gallons per Head.		Gallons per Head.		Gallons per Head.
Alexandria	18–20	Genoa	24½–97¾	Pietermaritzburg	44
Amsterdam	11·15	Hague	17·6	Riga	31·1
Adelaide	50	Hamburg	45½	Rio	30
Athens	21·56	Hanover	15·09	Rome	160·38
Baltimore	54	Hong Kong	5–18	Rotterdam	22·45
Barcelona	7–14	Kurrachee	25	Rouen	30·8
Berlin	13·3	Lahore	10	San Francisco	64½
Bombay	20	Lausanne	126	St. Petersburg	21·3
Boston	73·3	Liége	16½–30	Sanjago	5·6
Brisbane	33⅓	London	31¼	Seville	7·26
Buenos Ayres	20	Madrid	3·3	Stockholm	13½
Buda	12½	Marseilles	158·4	Stuttgart	26·4
Cairo	11	Montreal	60	Sydney	25
Calcutta	22	Munich	33	Toronto	82
Chicago	102½	Naples	15·4	Trieste	4·4
Christiania	39·7	New York	60·9	Valparaiso	20
Copenhagen	13·9	Ottawa	102½	Venice	8
Delhi	16	Paris	36	Vienna	13·20–19·8
Dresden	14·96	Pernambuco	7·3	Washington	143
Durban	2	Pest	33		
Frankfort	24	Philadelphia	54·15		

The quantity likely to be required for domestic purposes in any district is governed more by the facility with which the water can be disposed of after use than by any other consideration. In a town that is well drained, and contains houses fitted with baths and other conveniences, the consumption is only kept within bounds by the cost where water is sold by meter, and by special regulations strictly enforced on the consumer where it is sold according to the rateable value of the house supplied. The quantity required by manufacturers can be separately estimated.

An excess of water in a town provided with cesspools instead of drains is likely to prove injurious, as the water in passing through the cesspits is liable to saturate the surrounding soil with sewage, thus causing, by evaporation, a pestilential atmosphere.

6. MODES OF CHARGING CONSUMERS.—Considerable difference of opinion exists as to the most equitable mode of charging consumers for water supplied for domestic purposes. Water is sometimes sold by measure, but generally speaking payment is taken by a rate upon the annual value of the premises supplied. By the latter mode, the use of water is not restricted by any motives of economy; and the rates charged to houses of the better class admit of water being supplied to dwellings of the poorer class at a rate below that which would otherwise be possible. It cannot be denied, however, that under this system a considerable proportion of the water supplied to the consumer is wasted. Waste of water is the cause of additional outlay, not only in the construction of works, but in working expenses, and such additional outlay naturally entails a higher charge for the water than would otherwise be necessary. The meter system has no doubt some advantages, but there is a drawback to its use for domestic supply, which must not be overlooked, namely, the cost of providing and keeping the meters in repair, and the expense of the necessary inspection. The interest on the first cost, together with the expense of repairs and inspection, must fall on the consumers, and add to the charges they have to pay. It is possible that these considerations may have prevented the adoption of the meter system for general domestic purposes in some of our largest provincial towns, where the water supply is in the hands of the ratepayers.

7. DUAL SUPPLY.—In the case of many large towns an abundant supply of water of inferior quality is found in close proximity, while further off, but still within reasonable distance, a limited supply of better water exists, and it sometimes becomes a question whether both sources of

supply should not be adopted, the latter for drinking purposes, and the former for domestic and manufacturing uses. In the opinion of the writer, a system of dual supply is not practicable for domestic purposes alone, but only where municipal or manufacturing requirements have to be provided for as well.

When only one supply exists for domestic purposes, means are generally taken to render it as pure as possible, either by efficient filtration or by such other means as may be found necessary. A separate supply for municipal purposes can be used for road watering, sewer flushing, fires, &c., without affecting the domestic supply. In most manufacturing towns the factories are grouped together, and require large quantities of water at a cheap rate, which can often be supplied from sources sufficiently pure for purposes of manufacture, although it may be unfitted for household consumption.

A dual supply for domestic purposes would entail a considerable extra outlay on the construction of works, as a double line of mains would be necessary in every street, and the cost of most of the house fittings would be doubled, as they would have to be in duplicate. Another objection is the probability that the excellent quality of the water supplied for potable purposes would cause the quality of the other to be little considered, and the latter might be allowed to deteriorate, or become subject to contamination. Consumers, bearing this in mind, would probably use the purer water almost entirely. In ordinary times, this might not be of much consequence, but in times of drought it might be serious.

In connection with this subject, it may be mentioned as an interesting fact that when the Chelsea Water Company first moved their intake to Ditton a separate reservoir was constructed, and extra mains were laid for supplying unfiltered water for road watering and other purposes, but in practice this arrangement was found to be no saving, so it was discontinued, and now none but filtered water is supplied.

Where water pressure is required for power, it is advisable to have a separate system, as the pressure needed for its economical application is so much greater than that necessary for domestic supply. A moderately hard water is generally preferred for drinking, while for all cleansing and most manufacturing purposes soft water is considered better. In supplying a town, however, the health of the inhabitants should be the first consideration.

CHAPTER II.—WATER FILTRATION.

THE purity of a domestic water supply is undoubtedly a matter of the utmost importance, but what *is* pure water is a question which, in the absence of any recognised standard of purity, does not at present admit of any precise definition, inasmuch as different authorities on the subject hold different, and in some respects contradictory, theories regarding it. This much, however, is admitted—that efficient filtration is in most cases essential to purity.

When the supply of water is taken, as it is in the metropolis, from public waterworks, as much as possible is generally speaking done to ensure that the water as it leaves the reservoirs of the companies shall be perfectly fit for drinking. In the great majority of cases, unfortunately, before the water reaches the consumer, it has to pass through what has been, perhaps not too harshly, styled that domestic abomination—the water cistern, where the purest water is often liable to contamination from the dirty and neglected state of the cistern itself. The radical remedy for this state of things would be the universal adoption of the system of "constant supply." This, however, is still a question of the future, and consequently the use of filters is likely to continue to be general. It is obviously of great importance, where filters are used, that care should be taken to secure their continued efficiency, which is to a certain extent impaired by every drop of water that passes through them. Filters cannot be relied on for an indefinite period. After a while they become foul and inert.

There is therefore a point at which all filters not only cease to be efficient purifiers of water, but may themselves impart contamination. The length of time during which a filter will continue to work properly obviously depends, to a very great extent, upon the quality of the water passed through it. Water containing a large amount of contaminating matter must clog it up, and exhaust its oxidizing capabilities much faster than water which contains very little. If the house cistern from which the supply is drawn is kept clean, the water will require less filtering, and the filter will last all the longer. Comparing great things with small, the practice of the London Water Companies may be cited, who allow their supply to stand for some time in " subsidence reservoirs," in which much of the suspended matter gradually settles to the bottom, and from which the water is quietly drawn off for filtration, thus easing the work which the filter-beds have to do. Similarly, much may be done by a little care to prolong the efficiency of the domestic filter. The removal at intervals of the surface of the filtering material will also restore much of its capability of usefulness, since it is just the external coating that intercepts most of the solid matter the water may contain.

The process of filtration may be said to be both chemical and mechanical, especially in the case of large filter-beds, for a process of chemical decomposition goes on simultaneously with the merely mechanical process of straining. Decaying organic substances poured with the water into a filter-bed, are not merely arrested, but are rapidly decomposed and resolved into their elementary constituents, which again are promptly recombined in other forms. This chemical change is scientifically explained by the theory that every particle of sand is closely enveloped in a film of condensed air, and that the particles of organic matter being thus brought into close contact with a body of oxygen, undergo rapid decomposition. It is well known that all solid bodies attract about them an atmospheric film, and, therefore, as a bed of sand and gravel is an agglomeration of minute stones, each with its coating of compressed air (or, in other words, compressed oxygen and nitrogen), the water filtering through the interstices has to pass through a concentrated body of oxygen capable of rapidly decomposing it, and forming other compounds. Consequently, if we take the case of a decayed leaf, for example, we can see that it would be resolved to some extent into carbon, nitrogen, and hydrogen, which, recombining with the oxygen, form carbonic acid gas, ammonia, and water. As the result of this chemical process the polluting vegetable matter will have actually vanished, and though the filter-bed has really abstracted it from the percolating water, the bed itself will show no trace of it. Following out this theory, it has been asserted by chemists that when some of the London Companies drew their supplies from the tidal portion of the Thames where it received all the sewage of London, their filter-beds did not clog up nearly so fast as might have been expected. Scientific experiments showed that the filter-beds must have intercepted considerably more impurity than was actually found in them, and the phenomenon was explained by the theory that filtering was not merely a mechanical straining process, but one also of rapid chemical action, by which the polluting matter intercepted was destroyed and converted by oxidation.

The filter-beds of the London Companies consist of sand, gravel, &c. arranged in layers of varying thickness, and it is manifest that a considerable quantity of solid impurity must be removed from water by the merely mechanical process of straining through this porous mass. The polluting matter is arrested, to a great extent, by the sand and gravel, which, of course, after a while get choked up, becoming not merely less pervious to water, but also sources of contamination. It is consequently the practice of the Companies to remove the surface of the sand at frequent intervals, and periodically to renew the filter-beds entirely. But, curiously enough, it has been proved by careful scientific observation, that the filtering medium does not, as a matter of fact, become so rapidly clogged up as might be expected, judging by the amount of extraneous matter actually abstracted from the water. For the sake of illustration, let it be granted that a hundredweight of impure matter will in theory entirely destroy the filtering efficiency of a given quantity of sand, yet the latter will in reality abstract from the water passing through it more than a hundredweight of impure matter without wholly losing its filtering efficiency. In other words, a considerable proportion of the intercepted matter is oxidized, and the filter will be found upon examination to contain less contaminating substance than it can be proved to have intercepted from the water passed through it. This is only explainable by the theory of chemical change described above. A similar process goes on in the small domestic filter in which, instead of several feet of boulders, gravel, shells, and sand, there are only a few inches of some porous substance, presenting a certain amount of surface for the air to cling to and for the water to pass over.

From what has been said, it will be seen that there are two reasons why a filter must not be relied upon indefinitely for the purification of water. In the first place, it is gradually choked up by the pollution it is continually abstracting from the water passing through it, and in the next the air coating upon which the chemical action depends becomes exhausted, and the oxidizing process gradually ceases. The Water Companies are frequently blamed for delivering unpotable water, when if the true delinquent were sought it would be found to be the water consumer himself, whose lack of attention to his cisterns and filters has created the evil of which he complains.

SYSTEM OF THE LONDON WATER SUPPLY.

CHAPTER III.—HOW LONDON IS SUPPLIED.

1. *Preliminary Remarks.*

It is not altogether easy to realise the magnitude of the operations by which London is supplied with water. Nearly five millions of human beings have to be provided with that which is essential to their health and comfort, and the supply must never fail. In the following pages will be found a description of the plans adopted for this purpose, together with a history of the various Companies, tracing their gradual development from the commencement down to the present time. From the particulars given it will be seen that the existing supply may be regarded as satisfactory in most points, though many improvements could be introduced with advantage both to the consumers and the Companies: to the Companies by the prevention of the great waste that undoubtedly takes place, and to the consumers by the introduction of a constant supply direct from the mains, without the intervention of the contaminating cisterns at present so largely in use. The system of payment for water on the annual value of the house supplied has been and is the cause of considerable controversy, as are also the additional charges which the Companies are authorized to make for baths, high service, and other extras. With each re-valuation of property there is in some districts an increase in the rateable value, and it is a popular complaint that the Companies have the right to raise their charges without being obliged to give any equivalent benefit to the consumer. On the other hand, it is only fair to bear in mind that where the value of house property in any part of London declines, the Companies are compelled to take a reduced payment while rendering the same service as before; and they point out, moreover, that the parishes are constantly increasing the rateable value of the Companies' property.

The distribution of water under eight different Companies is not conducive to economy of management, and many improvements could undoubtedly be effected, with a saving of cost, if all were brought under one central authority. On reference to the Map (facing p. 33, *infra*) showing the districts over which each Company has the right of supply, it will be seen that nearly all the parishes are supplied in part by two, and many by more than two, Companies; each Company arranging with its neighbour a boundary line to govern the limits of the supply.

The Companies contend, with some reason, that if they were compelled to alter their mode of charge it would be a breach of faith on the part of Parliament, and would subvert the fundamental basis on which the shareholders subscribed their money. The acquisition of the Companies' undertakings by a central authority to be constituted for the purpose is a subject that has already engaged the serious attention of Parliament. It is to be hoped that, should such a transfer ever take place, these undertakings may be secured on reasonable terms, and that such arrangements as to charge will then be made as will meet the ideas of the day.

2. *Whence London is supplied.*

The water supply of London is drawn from the Rivers Thames and Lee, and from certain springs and underground sources in the valleys of those rivers, including Chadwell Spring, and eighteen wells sunk into the chalk, of which eight are in the north of London and ten in the south.

Early in 1884, the proportions taken from these several sources of supply were nearly as follows :—

From the Thames and certain chalk springs in the Thames Valley, about	50 parts of the whole
From the Lee and certain chalk springs in the Lee Valley, about	38 parts of the whole
From the 18 chalk-wells about .	12 ,,

In 1866 the proportions were 49 parts from the first group, 44 from the second, and only 7 from the chalk springs. It thus appears that the river supply forms a smaller proportion of the entire quantity now than formerly, while the proportion taken from the chalk wells is nearly doubled.

3. *By whom London is supplied, and under what control.*

London is supplied by eight Water Companies, which are controlled in common by certain general enactments, the Metropolis Water Acts of 1852 and 1871, and provisions in the Fire Brigade Act of 1865, also the Waterworks Clauses Act of 1847, which is expressly applied to them. But, subject to these general enactments, they are governed by their own special Acts, each Company having an independent area, a separate system of pipes, and peculiar regulations suitable to its own circumstances. The object of the Act of 1871, as specified in its preamble, was to make further provision for securing to the metropolis, and to certain places in the neighbourhood thereof, a constant supply of pure and wholesome water. Section 3 of the Act defines the term "Company" as meaning and including "The Governor and Company of the New River brought from Chadwell and Amwell to London, commonly called 'The New River Company;' The East London Waterworks; The Southwark and Vauxhall Water Company; The Company of Proprietors of the West Middlesex Waterworks Company; The Company of Proprietors of Lambeth Waterworks; The Governor and Company of Chelsea Waterworks; The Grand Junction Waterworks Company; The Company of Proprietors of the Kent Waterworks; and also any other corporation, company, board, commissioners, association, person, persons, or partnership, for the time being supplying water for domestic use within the limits of this Act."

4. *Sources whence each Company draws its Supply.*

The eight Water Companies are authorized to obtain their supply in the manner following:—

1. Kent Waterworks Company, from the Chalk wells between Crayford and Deptford.
2. New River Company, from the River Lee, and wells at Amwell End, Amwell Hill, Hoddesdon, Turnford, Cheshunt, Southgate, and Betstile and Broad Mead. The total volume which may be taken daily is unlimited.
3. East London Company, from the River Lee, from which the quantity that may be abstracted daily is unlimited; from deep wells in the chalk at Walthamstow and Chingford; and from the Thames at Sunbury, the volume to be abstracted daily at that place being limited to 10,000,000 gallons.
4. Southwark and Vauxhall Company, from the Thames at Hampton.
5. West Middlesex Company, from the Thames at Hampton.
6. Grand Junction Company, from the Thames and gravel beds at Hampton.

7. Lambeth Company, from the Thames at Molesey, and springs from the gravel beds and chalk at West Molesey and Ditton.
8. Chelsea Company, from the Thames at Molesey.

The volume which may be taken daily from the Thames is limited to 20,000,000 gallons for each of the Thames Companies, and 10,000,000 for the East London, making together 110,000,000 gallons, but from the other abovementioned sources the volume is unlimited.

5. *Amount expended by the Companies.*

As shown in the tabular Statement subjoined, the total certified expenditure of the Companies to December 31, 1883, amounted to £13,150,318. Subsequent to the passing of the Act of 1871, the Water Companies have, of their own accord, and in consequence of recommendations from the Metropolitan Water Examiner appointed under the Act, incurred and undertaken a considerable expenditure, amounting altogether to £3,175,320, for the improvement of the water supply both in quantity and quality, by extending the storage capacity of their reservoirs, and increasing their areas of filtration, as well as by providing for the requirements of constant supply, by the construction of high-service reservoirs for filtered water, the laying of mains, and the addition of powerful machinery to their works.

STATEMENT OF CERTIFIED EXPENDITURE OF THE EIGHT METROPOLITAN WATER COMPANIES ON WORKS, IMPROVEMENTS, &C., TO 31ST DECEMBER, 1883.*

Name of Company,	Total Certified Expenditure to 31st December, 1883. £	s.	d.
1. Kent	663,288	9	9 †
2. New River	3,321,100	7	5
3. East London	2,156,176	6	0
4. Southwark and Vauxhall	1,807,104	12	9
5. West Middlesex	1,159,312	15	4
6. Grand Junction	1,369,497	14	3
7. Lambeth	1,518,858	13	1
8. Chelsea	1,154,979	10	11
Total	13,150,318	9	6

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* It will be observed that the *Tables* 1A to 8A (*infra*), having been compiled for the International Health Exhibition, 1884, *prior* to the issue of the above Official Statement, only contain the Expenditure up to the 31st of December, 1882, in the case of the Kent, New River, and East London Companies, and up to the 31st of March, 1883, in the case of the remaining five.

† To the above total £663,288 9*s*. 9*d*., has to be added the sum of £75,284 18*s*. 9*d*., being the "Difference between the nominal value and the sums realised on the issue of Shares between 1809–58, confirmed and allowed, Kent Waterworks Act, 1862," thus making the total of £738,573 8*s*. 6*d*. shown in the Company's audited Accounts to the 31st of December, 1883.

CHAPTER IV.—THE METROPOLITAN WATER EXAMINER.

1. *His Duties.*

AMONGST the important provisions made by the Metropolis Water Act, 1871, in the interests of the consumers, was one which required the appointment of a Water Examiner, "being a competent and impartial person," who should from time to time examine the water supplied by any Company, in order to ascertain whether or not the Company had complied with the requirements of section 4 of the Metropolis Water Act of 1852, which enacts that "every Company shall effectually filter all water supplied by them within the Metropolis for domestic use, before the same shall pass into the pipes for distribution."

The effectual filtration of river water depends upon—

1stly. A sufficient area of properly constructed filter-beds, constantly cleaned and fresh sanded from time to time as the original thickness is reduced :

2ndly. The rate of filtration being controlled, and limited to a certain speed :

3rdly. The water delivered into the filter-beds having been previously stored in subsiding reservoirs, and the capacity of these reservoirs being such as to avoid the necessity for the intake of turbid and muddy water during the time of extraordinary and heavy floods, which tend to foul and choke the filters.

2. *Information given in his Reports.*

In addition to inspecting the filter-beds and reservoirs, and examining the quality of the water both at the intakes and after filtration at the works, the Water Examiner includes in his examination reports, which are published monthly and annually, the following information respecting each of the Metropolitan Water Companies :—

1. Source of supply.
2. Situation of the works.
3. Total volume which may be supplied daily, in gallons.
4. Average daily supply during each month, in gallons.
5. Estimated percentage delivered for other than domestic purposes.
6. Number of houses supplied.
7. Number of houses on constant supply.
8. Estimated population supplied within the districts of the Water Companies.
9. Number of subsiding and storage reservoirs for unfiltered water, showing the area in acres, and available capacity in gallons.
10. Number and capacity of the storage reservoirs for filtered water (covered within the radius prescribed).
11. Engine power, and horse power thereof.
12. Number of miles of mains in each district.
13. Number of miles of mains in the Metropolis.
14. Number of miles of streets with mains constantly charged, within the Metropolis.
15. Number of street hydrants and private fire-cocks erected within the Metropolis, and number of fire-plugs.
16. Greatest lift by steam power.
17. Greatest and least head of pressure in the district supplied.
18. Number of filter-beds, with area in acres.
19. Depth of sand and other materials composing filter-beds.
20. Maximum rate of filtration per square foot of filtering area, in gallons per hour.
21. Number of acres of filter-beds cleaned during each month.

22. Appearance of water before and after filtration.
23. Condition of samples taken daily.
24. Statement as to progress of works and alterations made by each Company, and of works proposed and recommended to be undertaken.
25. Analysis made by Dr. Frankland, F.R.S., of the water supplied to the Metropolis and other places.
26. Analysis of the water supplied to the Metropolis, made for the Companies by analysts of their own appointment.
27. Report made for the Metropolitan vestries by other chemists, on the organic matter in the water supplied to the Metropolis.

3. *Rate of Filtration in Theory and Practice.*

The water in the Thames and Lee during the winter months is frequently very turbid, and when in that condition is extremely difficult to deal with. The solid impurities in suspension are only practically got rid of by long subsidence previous to filtration, as they chiefly consist of clay, marl, and chalk in a very finely divided state; but the companies, being generally provided with sufficient storage reservoirs, are nearly always enabled to allow the turbid water to flow by, and only take in water when the rivers are at their best.

The rate of filtration of the Metropolitan water supply should not exceed 540 gallons per square yard of filter-bed each 24 hours, or $2\frac{1}{2}$ gallons per square foot per hour. Filtration ought to be effectual at this rate, which for all practical purposes may be considered as a standard. Effectual filtration is greatly facilitated by previous subsidence.

The average rate of filtration per square foot of filtering area per hour for each of the seven river Companies is as follows:—New River, $1\frac{1}{2}$; East London, $1\frac{1}{3}$; Southwark, $1\frac{1}{2}$; West Middlesex, $1\frac{2}{5}$; Grand Junction, $1\frac{3}{4}$; Lambeth, $2\frac{1}{8}$; and Chelsea, $1\frac{3}{4}$. No Company, therefore, now exceeds the desired rate of filtration.

4. *Matters to which Householders' attention should be given.*

The water as delivered by the Companies to their respective districts is, generally speaking, good in quality and effectually filtered, but it is frequently allowed to deteriorate after reaching the cistern of the consumer. The subject has already been adverted to in the chapter on Water Filtration (*ante*, p. 8). As there pointed out, the radical remedy for this lamentable state of things is undoubtedly a constant supply; but until such constant supply is general, the attention of all householders should be given to the fittings and cleanliness of their cisterns, as well as to their house drains, and the water pipes connected therewith. These are matters upon which depend in a great measure the purity and abundance of the domestic water supply.

The exercise of Government supervision tends to the effectual filtration and delivery of good water by the Companies to their respective districts; but an inspection of the cisterns in houses too frequently shows that they are in a state of foulness, which is generally attributable to neglect.

The attention of householders should also be given to the following points:—

1. All stop-valves should be fixed outside their premises. If the stop-valve is inside, then in the event of a severe frost, and a number of bursts occurring on the lead communication pipes, all the houses in the street are deprived of their supply during the whole time that the repairs are being effected on the burst pipes, whereas if the stop-valve is outside, it will only be necessary to shut it down.

2. Clause 14 of the Board of Trade Regulations, 1872, relating to waste pipes (see Appendix I., p. 212, *infra*), should be carried out in its integrity.

Contamination of water from gases generated by sewage is of far more frequent occurrence than is generally understood. Waste pipes from cisterns are still to be found which are in direct communication with drains, so that gases may flow back into the cisterns and become absorbed by the water. To prevent this an overflow pipe should be brought outside each house and the end left exposed to the air, instead of being carried into a drain, as is often the case. By the adoption of this plan the poisonous effluvia and gases from drains will be got rid of, which would otherwise ascend through the pipe, and not only be partly absorbed by the water in the cistern, but be partly mixed with the air in the house, thereby becoming a cause of fever and disease.

3. In houses supplied on the Constant System, all danger of drinking stale or contaminated water from cisterns may easily be avoided by attaching a small Draw-off Tap to the communication-pipe which supplies the cistern from the main in the street. Water may then be drawn at any moment, day or night, direct from the main.

5. *Rules to be observed in adopting Constant Supply.*

The Water Companies are gradually extending the system of Constant Supply in their respective districts. It would materially facilitate its general introduction if the following rules, based upon the Regulations as to fittings confirmed by the Board of Trade,* as provided in the Metropolis Water Act, 1871, were observed by water tenants in effecting the change from intermittent to constant supply, viz.:—

1. *Communication Pipes.*—Point of entry must be first approved by the company. Pipe to boundary fence should be new, or where the Company allow the existing lead communication pipes to remain, the strength and soundness will be entirely at the risk of the consumer. Weight of pipes to be as specified in Regulation 2.

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* For full text of these Regulations, with copy of Board of Trade minute confirming same, see Appendix I., *infra*, p. 208.

Iron pipes are not allowed if they are to be in contact with the ground.

Every house must have but one communication pipe.

Every house at present "branched," must have its own separate "communication pipe," except in the case of a group or block of houses (or those supplied by stand pipes) the water rates of which are paid by one owner; such owner may, at his option, have one sufficient communication pipe for such group or block.

The connection must be made by means of sound and suitable brass screwed ferrule or stop-cock, with union, and half-inch waterway.

The joints of the stop-cock and ferrule must be "wiped" by the consumer's plumber.

All joints must be of lead, and "wiped," or plumber's joints.

No pipe to be laid in or through drains or near gas pipes.

2. *Stop-valve.*—A sound and suitable screw-down stop-valve, not less than half-inch, and not greater than the pipe, must be fixed in the communication pipe at or near the entrance, and properly covered.

3. *Cisterns and Ball Valves.*—All cisterns must be above ground, properly covered, accessible for inspection and cleaning, and fitted with efficient ball-valves.

Wherever there is a wash-out pipe with ground plug, or any other kind of attachment, it must be connected to a warning-pipe.

4. *Standpipes.*—Standpipes or small cisterns, properly fitted, should be substituted for butts and underground cisterns.

Owners of small tenement houses are recommended, where practicable, to fix the standpipes in the kitchens or wash-houses, whereby they will be more protected from injury by frost or mischief, and future expense will be saved in repairs.

Standpipes must not be fixed over drains.

5. *Warning pipes.*—All waste-pipes must be removed or

converted into warning pipes, and so placed that the discharge of water may be readily seen by the officers of the Company. Such pipes to be of lead, and of the minimum weights specified in Regulation 29.

6. *Draw Taps.*—All draw taps must be sound and suitable, and of the "screw-down" kind.

Draw taps of the "screw-down" kind may be fixed on the rising main to supply water for drinking purposes.

Taps on the main over sinks ought to be of the "waste preventer" kind.

7. *Stand-Pipes in Courts.*—All stand-pipes or cocks fixed outside in courts or public places, to supply groups or blocks of houses, must be of the waste-preventer kind, and protected from injury by frost, theft, or mischief.

8. *Water-closets, &c.*—Water-closets, boilers, and urinals must be served through cisterns or service boxes, each water-closet, cistern, or service box to have an efficient waste-preventing apparatus, limiting the flush or discharge to two gallons of water, and urinals to one gallon.

Water-closet down pipes to be of dimensions and weight specified in Regulation 23.

9. *Baths.*—No bath to have any overflow pipe other than a warning-pipe. In every bath the outlet and inlet must be distinct and unconnected, the inlet to be above the highwater level, the outlet to have a water-tight plug, valve, or cock.

6. *Concerning the Extinction of Fires.*

None of the Companies are under any obligation to provide water sufficient for the extinction of fires; all that is required of them being to allow the gratuitous use of their water for this purpose, and to grant certain special facilities; such as keeping for inspection maps showing their pipeage and the spots where the screw-cocks are placed for regulating the service; and depositing keys of the fire-plugs at places prescribed by the Metropolitan

Board, so as to enable the firemen to act where they can without the Companies' turncocks. The fixing of fire-plugs was originally the duty of the parishes, but is now within the province of the Metropolitan Board, which can require the Companies to provide plugs at the Board's expense, but, as a matter of fact, the Companies provide them gratuitously. The value of Constant Supply for the purpose of fire extinction has been said with truth to be of even greater moment than its convenience to ordinary consumers.

CHAPTER V.—STATISTICS OF SUPPLY.

THE average daily supply of water furnished to the metropolis in 1883, for all purposes, was at the rate of 30.20 gallons per head of the population, and 226 gallons per house. This included the quantity used in the extinction of fires.

The number of houses returned shortly before the opening of the International Health Exhibition, 1884, as being under constant supply was 258,205, out of a total of 668,525.

A statement is appended showing the Unions supplied by the eight Metropolitan Water Companies, and also a List of the Districts supplied by each of them, and the names of the Parishes.

Accompanying this List is a map showing by colours the respective Districts actually supplied by the Companies as distinguished from their Limits of Supply under the various Acts of Parliament, which limits are also shown. The portions of the Districts under Constant Supply are marked, as are also those portions which are supplied by different Companies conjointly. The position of the respective Works of each company is indicated as well, the Pumping Stations, Reservoirs, and Filter-beds being each distinguished by particular marks.

The List of Districts is succeeded by eight Tables, which give full particulars relating to the Companies' Works, their sources of supply, situation, average daily quantity supplied by each, with the number of miles of mains, &c., as the same existed shortly before the opening of the International Health Exhibition of 1884.

The actual condition of these Works is described every month by the Water Examiner in his Reports, 250 copies of which are published and distributed regularly amongst the Water Companies, the Metropolitan Board of Works, the Vestries, the Medical Officers of Health, the London Press, and others interested in the subject of the London Water Supply.

The Following Statement Shews the Unions Supplied by the eight Metropolitan Water Companies.

Unions.	Area in Acres.	Sub-districts.	Name of Water Company giving Supply in the District.
West District.			
Kensington	3441	Kensington Town	West Middlesex.
		Brompton	Do. and Chelsea.
Fulham	4209	St. Peter's, Hammersmith	Do.
		St. Paul, Do.	Do. and Grand Junction.
		Fulham	Do. and Chelsea.
Paddington	1251	St. Mary, Paddington	Grand Junction and West Middlesex.
		St. John, Do.	Grand Junction.
Chelsea	861	Chelsea, South	Chelsea.
		Chelsea, North-west	Do.
		Chelsea, North-east	Do.
St. George's	2051	Hanover Square	Grand Junction.
		May Fair	Do.
		Belgravia	Chelsea.
Westminster	216	St. John, Westminster	Do.
		St. Margaret, Westminster	Do.
		Golden Square	Grand Junction.
		Berwick Street	New River and Grand Junction.
		St. Anne, Soho	New River.
North District.			
St. Marylebone	1506	All Souls, Marylebone	West Middlesex.
		Cavendish Square	Do.

STATEMENT SHEWING THE UNIONS SUPPLIED—*continued.*

Unions.	Area in Acres.	Sub-districts.	Name of Water Company giving Supply in the District.
North District—contd.			
St. Marylebone		Rectory, Marylebone	Grand Junction and West Middlesex.
		St. Mary, Do.	Do. Do.
		Christchurch, Marylebone	West Middlesex.
		St. John, Marylebone	Do.
Hampstead	2248	Hampstead	New River and West Middlesex.
St. Pancras	2672	Regent's Park, Pancras	West Middlesex.
		Tottenham Court	New River and West Middlesex.
		Gray's Inn Lane	New River.
		Somer's Town	Do.
		Camden Town	Do.
		Kentish Town	Do.
Islington	3107	Islington, West	Do.
		Do. East	Do.
Hackney	3935	Stoke Newington	Do.
		Stamford Hill	East London.
		West Hackney	New River.
		Hackney	East London and New River.
		South Hackney	East London.
Central District.			
St. Giles and St. George, Bloomsbury	245	St. George, Bloomsbury.	New River.
		St. Giles, South	Do.
		St. Giles, North	Do.

Strand	433	St. Martin-in-the-Fields	New River and Chelsea.
		St. Mary-le-Strand.	New River.
		St. Clement Danes.	Do.
Holborn	816	St. George-the-Martyr	Do.
		St. Andrew Eastern	Do.
		Saffron Hill	Do.
		St. James, Clerkenwell	Do.
		Amwell, Do.	Do.
		Pentonville	Do.
		Goswell Street	Do.
		Old Street	Do.
		City Road	Do.
		Whitecross Street	Do.
City of London	731	Finsbury	New River and East London.
		St. Botolph	New River.
		Cripplegate	Do.
		St. Sepulchre	Do.
		St. Bride	Do.
		Castle Baynard	Do.
		Christchurch	Do.
		Queenhithe	Do
		Allhallows Barking	Do.
		Broad Street	
East District.			New River and East London.
Shoreditch	648	Holywell, Shoreditch	New River.
		St. Leonard, Do.	Do.
		Hoxton New Town	Do.
		Hoxton Old Town	New River and East London.
		Haggerston	East London.

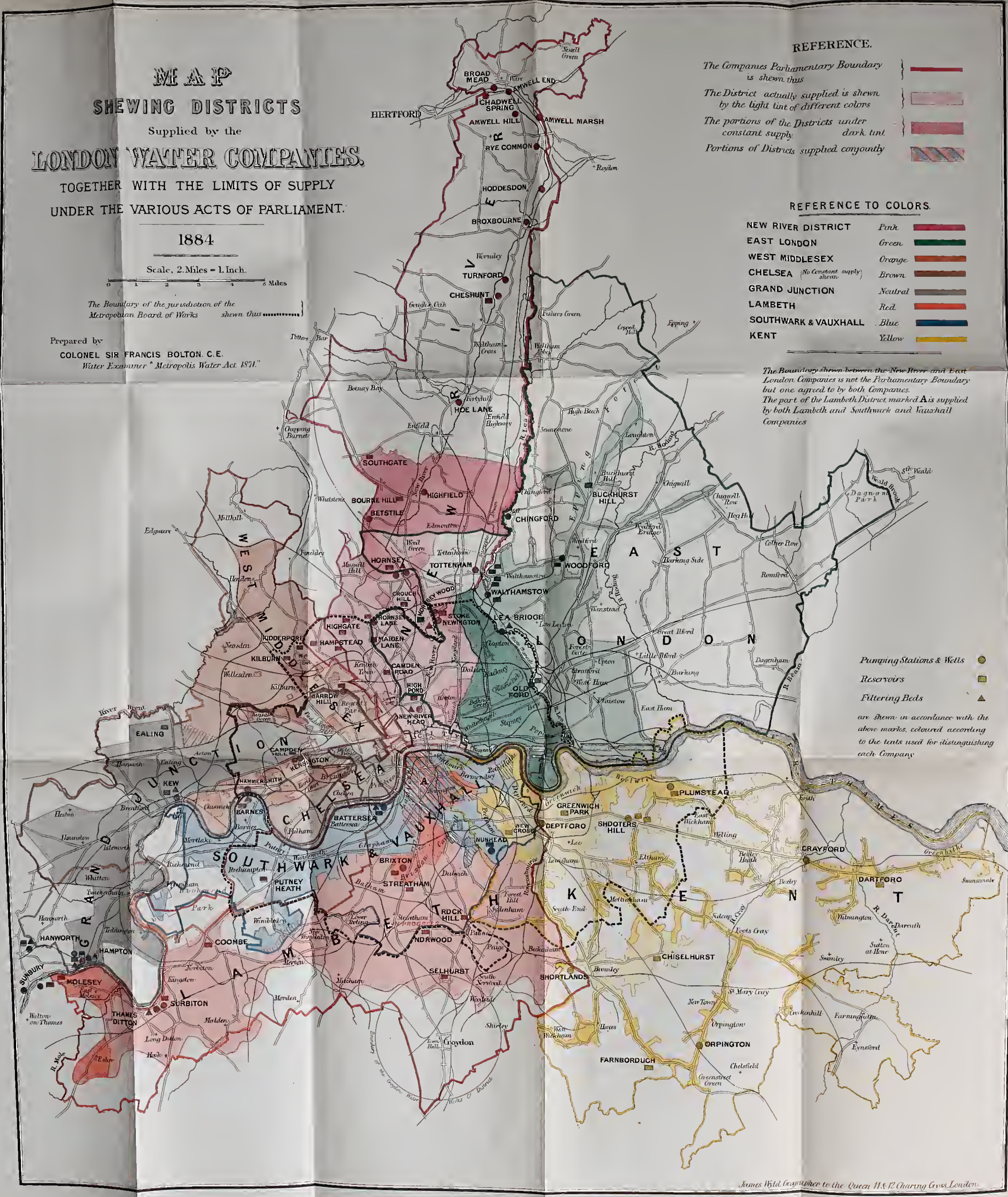
STATEMENT SHEWING THE UNIONS SUPPLIED—*continued.*

Unions.	Area in Acres.	Sub-districts.	Name of Water Company giving Supply in the District.
East District—contd.			
Bethnal Green	755	Hackney Road	Do.
		Green, Bethnal Green	Do.
		Church, Do.	Do.
	405	Town, Do.	East London and New River.
Whitechapel		Spitalfields	East London.
		Mile End New Town	East London and New River.
		Whitechapel, North	East London.
		Whitechapel Church	Do.
		Goodman's Fields	New River and East London.
		Aldgate	New River.
St. George-in-the-East . .	244	St. Mary, St. George-in-the-E.	East London.
		St. Paul, Do.	Do.
		St. John, Do.	Do.
Stepney	569	Shadwell	East London and New River.
		Ratcliff	East London.
		Limehouse	Do.
Mile End Old Town . . .	679	Mile End Old Town, West	Do.
		Do. East	Do.
Poplar	2,648	Bow	Do.
		Bromley	Do.
		Poplar	Do.

South District.			
St. Saviour's, Southwark . .	1,170	Christchurch, Southwark	Lambeth and Southwark and Vauxhall.
		St. Saviour, Southwark	Southwark and Vauxhall.
		Kent Road	Southwark and Lambeth.
		Borough Road	Do. Do.
		London Road	Do. Do.
		Trinity, Newington	Do. Do.
		St. Peter, Walworth	Do. Do.
		St. Mary, Newington	Do. Do.
St. Olave's, Southwark . .	1,728	St. Olave, Southwark	Southwark and Vauxhall.
		St. John, Horselydown	Do. Do.
		Leather Market	Southwark and Vauxhall and Lambeth.
		St. Mary Magdalen	Southwark and Vauxhall.
		St. James, Bermondsey	Do. Do.
		Rotherhithe	Southwark and Vauxhall and Kent.
Lambeth	4,060	Waterloo Road, 1st	Lambeth and Southwark and Vauxhall.
		Do. 2nd	Do. Do. Do.
		Lambeth Church, 1st	Lambeth and Southwark and Vauxhall.
		Do. 2nd	Do. Do. Do.
		Kennington, 1st	Southwark and Vauxhall and Lambeth.
		Do. 2nd	Do. Do. Do.
		Brixton	Lambeth and Southwark and Vauxhall.
		Norwood	Lambeth.
Wandsworth and Clapham .	11,707	Clapham	Southwark and Vauxhall.
		Battersea	Do. Do.
		Wandsworth	Do. Do.
		Putney	Do. Do.
		Streatham	Lambeth.
Camberwell . . .	4,450	Dulwich	Lambeth and Southwark and Vauxhall.

STATEMENT SHOWING THE UNIONS SUPPLIED—*continued*:

Unions.	Area in Acres.	Sub-districts.	Name of Water Company giving Supply in the District.
South District—contd.			
Camberwell.		Camberwell	Southwark and Vauxhall and Lambeth.
		Peckham	Southwark and Vauxhall and Lambeth and Kent.
		St. George, Camberwell	Lambeth and Southwark and Vauxhall.
Greenwich	3,801	St. Paul, Deptford	Kent.
		St. Nicholas, Do.	Do.
		Greenwich, West	Do.
		Do., East	Do.
Lewisham	11,436	Eltham	Do.
		Lee	Do.
		Lewisham Village	Do.
		Sydenham	Lambeth.
Woolwich	7,281	Charlton	Kent.
		Woolwich Dockyard	Do.
		Do. Arsenal	Do.
		Plumstead, West	Do.
		Do., East	Do.



MAP
SHEWING DISTRICTS
Supplied by the
LONDON WATER COMPANIES.
TOGETHER WITH THE LIMITS OF SUPPLY
UNDER THE VARIOUS ACTS OF PARLIAMENT.

1884

Scale, 2 Miles = 1 Inch.

The Boundary of the jurisdiction of the Metropolitan Board of Works shewn thus ....

Prepared by
COLONEL SIR FRANCIS BOLTON, C.E.
Water Examiner "Metropolis Water Act 1871."

REFERENCE.

The Companies Parliamentary Boundary is shewn thus

The District actually supplied is shewn by the light tint of different colors

The portions of the Districts under constant supply dark tint

Portions of Districts supplied conjointly

REFERENCE TO COLORS.

NEW RIVER DISTRICT	*Pink*	🟥
EAST LONDON	*Green*	🟩
WEST MIDDLESEX	*Orange*	🟧
CHELSEA (*No Constant supply shewn*)	*Brown*	🟫
GRAND JUNCTION	*Neutral*	⬜
LAMBETH	*Red*	🟥
SOUTHWARK & VAUXHALL	*Blue*	🟦
KENT	*Yellow*	🟨

The Boundary shewn between the New River and East London Companies is not the Parliamentary Boundary but one agreed to by both Companies.
The part of the Lambeth District marked **A** *is supplied by both Lambeth and Southwark and Vauxhall Companies*

Pumping Stations & Wells ●
Reservoirs ▭
Filtering Beds ▲
are shewn in accordance with the above marks, coloured according to the tints used for distinguishing each Company

James Wyld, Geographer to the Queen 11 & 12 Charing Cross, London.

THE FOLLOWING IS A LIST OF THE DISTRICTS SUPPLIED BY THE EIGHT METROPOLITAN WATER COMPANIES AND THE NAMES OF THE PARISHES.

1. The places and parishes in which the Kent Company supply water are as follows:—

St. Paul's, Deptford.
St. Nicholas, Deptford.
Greenwich.
Woolwich.
Charlton.
Lee.
Plumstead.
Eltham.
Bromley.
Crayford.
Dartford.
Bexley.
Erith.
Chiselhurst.
Mottingham.
Kidbrooke.

And parts of the parishes of Lewisham, Camberwell, and Rotherhithe.

No part of the Company's district is jointly in supply with any other Company.

2. The places and parishes in which the New River Company supply water are as follows:—

St. Martin-in-the-Fields.
St. Paul, Covent Garden.
St. Mary-le-Strand.
St. Clement Dane
Savoy Precinct.
St. John-the-Baptist, Savoy, Strand.
St. James, Westminster.
St. Anne, Soho.
Rolls Liberty.
St. Andrew, Holborn-above-Bars.
St. George-the-Martyr.
Saffron Hill.
Hatton Garden.
Ely Rents.
Ely Place.
St. Sepulchre Without.
St. Giles-in-the-Field.
St. George, Bloomsbury.
St. James and St. John, Clerkenwell.
St. Luke, Middlesex.
St. Mary, Islington.
St. Pancras.
Holy Trinity, Minories.
St. Katherine Precincts (Docks).
The City of London.
St. Mary, Whitechapel.
Christchurch, Spitalfields.
Norton Folgate.
St. Leonard, Shoreditch.
St. John, Hackney.
St. Mary, Hornsey.

St. Mary, Stoke Newington.
Highgate Hamlet.
St. John, Hampstead.
St. Botolph, Aldgate Without.
Inner Temple.
Middle Temple.
Thavie's Inn.
Staple Inn.
Barnard's Inn.
Lincoln's Inn.
Gray's Inn.
Great and Little Amwell.
St. Margaret.
Hoddesdon.
Wormley.
Broxbourne.
Cheshunt.
Enfield.
Edmonton.
Tottenham.

The undermentioned parishes are supplied by the New River Company, in conjunction with other Companies or Boards:—

St. Martin-in-the-Fields.
St. James, Westminster.
St. Pancras.
St. Katherine Precinct.
St. Mary, Whitechapel.
Christchurch, Spitalfields.
Norton Folgate.
St. Leonard, Shoreditch.
St. John, Hackney.
St. Mary, Stoke Newington.
St. John, Hampstead.
Enfield.
Tottenham.

3. The places and parishes in which the East London Wate works Company supply water are as follows:—

In the County of Middlesex:—

Whitechapel.
Mile End Old Town.
Mile End New Town.
Spitalfields.
Bishopsgate (part of).
Artillery Ground.
St. Botolph, Aldgate (part of).
St. George-in-the-East.
Shadwell.
Limehouse.
Wapping.
Ratcliff.
Bow.
Bromley.
Poplar.
Bethnal Green.
Shoreditch (part of).
Hackney.
Tottenham (part of).

In the County of Essex:—

West Ham.
East Ham.
Low Leyton.
Walthamstow.
Wanstead.
Woodford.
Chigwell.
Loughton.

In practice the Company do not supply any district in which another Company has pipes, but the Parliamentary district, which the Company are authorised to supply, includes:

Bishopsgate Within.
St. Luke, Old Street.
Stoke Newington.
Tottenham.
Kingsland.
Shacklewell
and
Holloway.

Which are supplied by the New River Company.

4. The places and parishes in which the Southwark and Vauxhall Waterworks Company supply water are as follows:—

Barnes.
Battersea.
Bermondsey.
Clapham.
East Sheen.
Ham.
Kew.
Mortlake.
Putney.
Petersham.
Richmond (part of).
Roehampton.
Sheen.
Wandsworth.
Wimbledon (part of).
St. Giles, Camberwell.
St. Mary, Newington.
St. Mary, Wimbledon.
St. Mary, Lambeth.
St. Mary, Rotherhithe.
St. Saviour's, Southwark.
St. John's, Southwark.
St. Olave's, Southwark.
St. Thomas, Southwark.

(Wholly or partly).

The only parts of the district supplied by the Southwark and Vauxhall Company, and also by the Lambeth Company, are parts of the parishes of

Lambeth.
Newington.
Camberwell.
St. George's.
Christchurch.
Bermondsey
and
Clapham.

5. The places and parishes in which the West Middlesex Waterworks Company supply water are as follows:—

Hampstead.	Conjointly	with the	New River Company.
St. Pancras.	,,	,,	do.
St. Ann's, Soho.	,,	,,	do.
St. James, Westminster.	,,	,,	do.
St. Marylebone.	,,	,,	Grand Junction Coy.
Paddington.	,,	,,	do.
Chiswick.	,,	,,	do

Hammersmith.	Conjointly with the Grand Junction Co.
Kensington.	,, ,, do. and Chelsea Coys.
Chelsea.	,, ,, Chelsea Coy.
St. Margaret's, Westminster.	,, ,, do.
Fulham.	,, ,, do.

Also the Suburban parishes of Willesden and Hendon, in which places there is no other Water Company.

6. The places and parishes in which the Grand Junction Waterworks Company supply water are as follows:—

St. James, Westminster (part of).
St. George's, Hanover Square (the inward of).
St. Marylebone (part of).
Paddington.
Kensington (North part of).
Hammersmith (part of).
Chiswick.
Acton.
Ealing.
New Brentford.
Heston.
Hounslow.
Isleworth.
Hanwell.
Twickenham.
Hampton.
Hampton Wick.
Teddington.
Hampton Court.
Bushey Park.
Whitton.
Hanworth.

The only portion of the district supplied by the Grand Junction Company, and also by another Company, is a part of Paddington, and a small part of Kensington, in which the West Middlesex Company have pipes also.

7. The places and parishes in which the Lambeth Waterworks Company supply water are as follows:—

Thames Ditton.
Esher.
Long Ditton.
Kingston-upon-Thames.
Maldon.
Morden.
Wimbledon.
Merton.
Mitcham.
Tooting Graveney.
Clapham.
Wandsworth.
Battersea.
Streatham.
Croydon.
St. Mary, Newington.
Camberwell.
Bermondsey.
St. Mary, Lambeth.
St. Saviour.
St. George-the-Martyr.
Christchurch.

in the County of Surrey, and such part of the parishes of Beckenham and Lewisham as lie on the western side of the River Ravensbourne.

A portion of the district is also supplied by the Southwark and Vauxhall Company.

8. The places and parishes in which the Chelsea Waterworks Company supply water are as follows :—

St. Luke, Chelsea.
All Saints, Fulham (part of).
St. Mary Abbott's, Kensington (part of).
Kensington Palace and Precincts thereof.
St. George, Hanover Square (the out-wards).
St. James, Westminster (part of).
St. Martin-in-the-Fields (part of).
St Margaret, Westminster.
St. John the Evangelist, Westminster.

The Chelsea Company supply the whole of the district with the exception of the public buildings in the neighbourhood of Whitehall and Palace Yards, which are supplied by Government.

TABLE No. 1.—THE KENT WATERWORKS.

Source of Supply or Intake.	Situation of Works.	Average Daily Supply. Gallons.	Approximate per-centage delivered for other than domestic purposes.	Number of Supplies to Houses, &c., returned.	Number of Houses on constant Supply.	Estimated population supplied within the Districts of the Water Companies.	Storage Filtered Water Covered Reservoirs within the Radius prescribed.		Engine Power.		Number of Miles of Mains.	Number of Miles of Mains in the Metropolis.	Number of Miles of Streets with Mains constantly charged within the Metropolis.	Number of Street Hydrants and private Fire-cocks erected within the Metropolis.	Greatest lift by Steam Power.	Head of Pressure in the District supplied.	
							No.	Capacity. Gallons.	No.	Horse power.						Greatest.	Least.
Ten chalk wells, namely:— Deptford, 3; Plumstead, 1; Shortlands, 2; Crayford, 3; Farnborough, 1.	. . . .	9,337,644	20	60,672	28,789	364,032	..	..	..	..	443	275	85	554 on public roads.	Feet. 300	Feet. 250	Feet. ..
	New Cross . .	..		..	..	..	1	1,750,000	..	..					..	..	50
	Deptford . .	..		..	..	..	2	2,000,000	8	858					..	..	..
	Woolwich Com.	..		..	..	..	1	1,500,000	..	..					..	..	..
	Plumstead Com.	..		..	..	..	2	850,000	1	63			475 in Government Establishments. 257 Private. 180 for road watering.		..	..	..
	Greenwich Park	..		..	..	..	1	1,125,000	..	..					..	..	..
	Chislehurst .	..		..	..	..	1	450,000	..	..					..	..	..
	Shortlands . .	..		..	..	..	..	..	2	93					..	..	..
	Crayford . .	..		..	..	..	..	..	3	186					..	..	..
	Dover Road . Shooter's Hill .	..		..	..	..	1	300,000	2	47					..	..	..
	Farnborough .	..		..	..	..	1	1,400,000	1	120					..	..	..
	Dartford . .	..		..	..	..	1	370,000	..	..					..	..	..
	Total of Kent Waterworks	9,337,644	..	60,672	28,789	364,032	11	9,745,000	17	1,367	443	275	85	1,466	..	..	..

TABLE No. 2.—THE NEW RIVER COMPANY.

Intake	Situation of Works.	Total Volume which may be supplied daily. Gallons.	Average Daily Supply. Gallons.	Approximate percentage delivered for other than domestic purposes.	Number of Supplies to Houses, &c., returned.	Number of Houses on constant Supply.	Estimated Population supplied within the Districts of the Water Companies.	Subsiding and Storage Reservoirs for Unfiltered Water.			Storage Filtered Water Covered Reservoirs within the Radius prescribed.		Engine Power.		Number of Miles of Mains.	Number of Miles of Mains in the Metropolis.	Number of Miles of Streets with Mains constantly charged within the Metropolis.	Number of Street Hydrants and private Fire-cocks erected within the Metropolis.	Greatest lift by Steam Power.	Head of Pressure in the District supplied.		Filters.				
								No.	Area in Acres.	Available Capacity. Gallons.	No.	Capacity. Gallons.	No.	Horse Power.						Greatest.	Least.	Filter beds. No.	Filter beds. Area in Acres.	Depth of Sand and other Materials.	Maximum Rate of Filtration per Square Foot of Area in Gallons per Hour.	No. of Acres in Filter Beds cleaned per Month.
From Chadwell Spring, the River Lee, and eight wells.	. . . .	Not restricted	24,063,581 filtered, of which 4,195,116 were drawn from springs and wells and 19,868,465 from the Lee; and 1,906,419 unfiltered, of which only 5,966 were drawn from Hampstead and Highgate Ponds.	19 exclusive of waste.	140,698	20,305	1,038,000	..	..	..	..	..	..	..	327 and 445 miles of services.	290 and 440 miles of services.	219	1,230 public 344 for street watering 2,517 Private and about 15,000 fire plugs.	Feet. 270	260	40	..	..	ft. in. Sand . . 2 3 Gravel . . 3 0 Increasing in coarseness towards bottom.	1½	8½
	New River Head . . .	..			..	..	..	1	¾	700,000	..	..	2	200					..	..	..	3	2¼		..	..
	Claremont Square . . .	..			..	..	..	..	..	..	1	3,500,000	..	..					..	..	..	..	..		..	..
	Stoke Newington . . .	..			..	..	..	2	42¼	90,000,000	..	..	8	1,080					..	..	..	9	9		..	..
	Hornsey	..			..	..	..	2	8	8,500,000	..	..	4	440					..	..	..	8	5¼		..	..
	Maiden Lane	..			..	..	..	..	..	..	2	15,000,000	..	..					..	..	..	..	..			
	Hornsey Lane	..			..	..	..	..	..	..	1	3,000,000	2	75					..	..	..	..	..			
	Highgate	..			..	..	..	13	30	30,000,000	1	1,000,000	..	..					..	..	..	..	..			
	Hampstead	..			..	..	..				1	500,000	..	..					..	..	..	..	..			
	Camden Park Road . .	..			..	..	..	1	1	900,000	..	..	..	..					..	..	..	..	..			
	Amwell End (well) . .	..			..	..	..	..	..	..	..	..	1	50					..	..	..	..	..			
	Amwell Hill (well) . .	..			..	..	..	..	..	..	..	..	2	75					..	..	..	..	..			
	Amwell Marsh (well) .	..			..	..	..	..	..	..	..	..	..	..					..	..	..	..	..			
	Hoddesdon (well) . . .	..			..	..	..	..	..	..	..	..	1	50					..	..	..	..	..			
	Turnford (well)	..			..	..	..	..	..	..	..	..	2	150					..	..	..	..	..			
	Cheshunt (well and reservoir)	..			..	..	..	2	18½	39,000,000	..	..	1	20					..	..	..	..	..			
	Tottenham	..			..	..	..	..	..	..	..	..	2	125	Not in use.				..	..	..	..	..			
	Southgate	..			..	..	..	..	..	..	1	1,000,000	..	..					..	..	..	..	..			
	Betstile (well)	..			..	..	..	..	..	..	..	..	2	24					..	..	..	..	..			
	Crouch Hill	..			..	..	..	..	..	..	2	12,000,000	..	..					..	..	..	..	..			
	Broad Mead (well) . . .	..			..	..	..	..	..	..	..	..	1	16					..	..	..	..	..			
	Rye Common (well) . .	..			..	..	..	..	..	..	..	..	2	200					..	..	..	..	..			
	Hoe Lane (well) . . .	..			..	..	..	..	..	..	..	..	2	170					..	..	..	..	..			
	Bourne Hill	..			..	..	..	..	..	..	1	1,500,000	..	..					..	..	..	..	..			
	Total of New River Company . .	..	25,970,000	..	140,698	20,305	1,038,000	21	100¾	169,100,000	10	37,500,000	32	2,675	772	730	219	4,091	..	..	..	20	16½	5' 3"	1½	8½

TABLE No. 3.—THE EAST LONDON WATERWORKS.

From the River Lee and Thames at Sunbury, & wells.	. . . .	From Thames, 10,000,000	From Thames Nil.	31 exclusive of waste.	143,512	119,889	1,076,340	..	..	..	..	..	..	..	190 mains. 348 services.	110 mains. 205 services.	120 Many streets with 3 some with 5 lines of pipes.	600 private hydrants, and about 10,000 fire plugs.	..	220 upon serving mains.	40	..	..	ft. in. Sand. . . 2 0 Hoggin . . 0 6 Coarse Gravel 1 0	1⅓	11¼
	Old Ford	..	..		..	..	..	..	..	..	1	1,500,000	6	800					335	..	..	..	..		..	..
	Walthamstow	From Lee, not restricted.	From Lee, 33,854,330		..	..	..	8	220	600,000,000	..	..	1	75					..	..	..	..	..		..	..
	Lee Bridge	..	..		..	..	..	..	..	..	..	..	7	1,050					140		..	25	24		..	..
	Woodford Works . . .	..	..		..	..	..	..	..	..	2	3,000,000	2	120					160	..	..	..	..		..	..
	Sunbury	..	..		..	..	..	..	..	..	..	..	2	150					..	..	..	..	..		..	..
	Hanworth	..	..		..	..	..	1	2	5,000,000	2	2,500,000	3	600					175			6	5		..	..
	Hornsey Wood	..	..		..	..	..	..	..	..	1	5,000,000	..	..					For Thames supply.	..	..	..	..		..	..
	Chingford (well) . . .	..	..		..	..	..	..	..	..	..	..	..	..						..	..	..	..		..	..
	Buckhurst Hill	..	..		..	..	..	..	..	..	1	70,000	..	..						..	..	..	..		..	..
	Total of East London Waterworks . .	10,000,000	33,854,330	..	143,512	119,889	1,076,340	9	222	605,000,000	7	12,070,000	21	2,795	538	315	120	600	..	..	..	31	29	3' 6"	1⅓	11¼

TABLE No. 4.—THE SOUTHWARK AND VAUXHALL WATERWORKS.

From the Thames at Hampton.	. . . .	20,000,000	19,940,649	15 to 20 exclusive of waste.	101,481	10,000 exclusive of houses, factories, &c. supplied by Meter.	754,003	..	..	..	..	..	..	..	711 including services.	546 including services	130 including services.	11,700 Fire-plugs.	360	170	20	..	..	ft. in. Harwich sand 3 0 Hoggin . . 1 0 Fine gravel . 0 9 Coarse gravel 0 9	1½	13
	Hampton	..	..		..		..	3	5½	20,000,000	..	..	5	800					..	..	..	3	3¼		..	..
	Battersea	..	..		..		..	3	12	46,000,000	..	..	6	1,200					..	..	..	9	11¼		..	..
	Nunhead	..	..		..		..	..	..	..	4	18,000,000	2	100					..	..	..	..	..		..	..
	Total of Southwark and Vauxhall Waterworks	20,000,000	19,940,649	..	101,481	10,000	754,003	6	17½	66,000,000	4	18,000,000	13	2,100	711	546	130	..	..	..	..	12	14½	5' 6"	1⅓	13

TABLE No. 5.—THE WEST MIDDLESEX WATERWORKS.

From the Thames at Hampton.	. . . .	20,000,000	12,799,975	14 exclusive of waste.	63,898	15,702	479,235	..	..	..	..	..	..	..	402 of which 183⅓ miles are constantly charged.	307 of which 136 miles are constantly charged.	About 91	None, about 5,000 fire-plugs.	..	..	..	..	..	ft. in. Harwich sand 2 3 Barnes sand 1 0 Gravel . . 2 3 Screened to different sizes and arranged in layers.	1½	10¾
	Hampton	..	..		..	..	..	..	..	..	..	..	3	360					..	..	..	..	..			
	Hammersmith	..	..		..	..	..	..	..	..	..	..	8	1,335					195	190	130	..	..			
	Barnes	..	..		..	..	..	4	37	117,500,000	..	..	1	6					..	..	..	8	12			
	Camden Hill	..	..		..	..	..	..	..	..	1	3,672,000	..	..					..	..	..	..	..			
	Barrow Hill	..	..		..	..	..	..	..	..	1	4,750,000	2	90					150	..	..	..	..			
	Finchley Road . . .	..	..		..	..	..	..	..	..	1	2,500,000	..	..					..	..	..	..	..			
	Total of West Middlesex Waterworks	20,000,000	12,799,975	..	63,898	15,702	479,235	4	37	117,500,000	3	10,922,000	14	1,791	402	307	91	..	..	..	..	8	12	5' 6"	1½	10¾

TABLE No. 6.—THE GRAND JUNCTION WATERWORKS.

From the Thames at Hampton.	. . . .	20,000,000	14,128,744	Not returned.	48,535	30,287	436,815	..	..	..	..	..	..	..	352 of which 262 miles are constantly charged	175 of which 85 miles are constantly charged.	62	None but 7,202 fire plugs, of which 4,224 are attached to pipes constantly charged.	210	150	30	..	..	ft. in. Harwich sand 2 6	1¾	8¾
	Hampton	..	..		..	..	..	3	12	51,000,000	1	2,500,000	7	1,149					..	..	..	3	2¼	Hoggin . . 0 6	..	..
	Kew	..	..		..	..	..	2	5	13,500,000	1	2,500,000	6	1,031					..	..	..	7	8½	Fine gravel . 0 9	..	..
	Camden Hill	..	..		..	..	..	..	..	..	3	18,000,000	3	532					..	..	..	..	..	Coarse gravel 0 9	..	..
	Kilburn	..	..		..	..	..	..	..	..	1	6,000,000	..	..					..	..	..	..	..	Boulders . 1 0	..	..
	Hanger Hill, Ealing . .	..	..		..	..	..	..	..	..	1	3,000,000	..	..					..	..	..	..	..		..	..
	Total of Grand Junction Waterworks	20,000,000	14,128,744	..	48,535	30,287	436,815	5	17	64,500,000	7	32,000,000	16	2,712	352	175	62		..	..	..	10	10¾	5' 6"	1¾	8¾

TABLE No. 7.—THE LAMBETH WATERWORKS.

From the Thames at Molesey.	. . . .	20,000,000	14,248,300	25 exclusive of waste.	76,932	29,536	538,524	..	..	..	..	..	..	..	635	407	150	167 Public. 300 for street watering. 100 Private & about 10,000 fire plugs.	380	380 upon pumping mains. 150 upon serving mains.	20	..	..	ft. in. Thames sand 3 0	2	3¾
	Molesey	..	..		..	..	..	3	30	125,000,000	..	..	2	100	including Services.				..			8	..	Shells, &c. . 1 0	..	..
	Long Ditton	..	..		..	..	..	2	1	3,000,000	..	..	12	1,550					..			..	7½	Coarse gravel 3 0	..	..
	Brixton	..	..		..	..	..	..	..		2	12,000,000	12	930					..			..	..			
	Streatham	..	..		..	..	..	..	..		2	7,500,000	..	..					..			..	..			
	Selhurst	..	..		..	..	..	..	..		1	2,500,000	..	..					..			..	..			
	Rockhill	..	..		..	..	..	..	..		1	615,000	..	..					..			..	..			
	Coombe	..	..		..	..	..	..	..		1	1,150,000	..	..					..			..	..			
	Norwood	..	..		..	..	..	..	..		1	5,000,000	..	..					..			..	..			
	Total of Lambeth Waterworks	20,000,000	14,248,300	..	76,932	29,536	538,524	5	31	128,000,000	8	28,765,000	26	2,580	635	407	150	567	..	..	..	8	7½	7' 0"	2	3¾

TABLE No. 8.—THE CHELSEA WATERWORKS.

From the Thames at Ditton and Molesey.	. . . .	20,000,000	9,525,440	15 exclusive of waste.	32,797	3,697	257,604	..	..	..	..	..	..	..	215	193	70	None about 4,918 fire-plugs.	175	140	40	..	..	ft. in. Thames sand 4 6	1¾	4
	Walton and Molesey . .	..	..		..	..	..	4	40	140,000,000	..	..	2	100	..	..	..		..	..	..	..	..	Shells, &c. . 0 3	..	..
	Seething Wells	..	..		..	..	..	..	..	..	..	..	8	1,025	..	..	..		..	..	..	7	6¾	Gravel . . 3 3	..	..
	Putney Heath	..	..		..	..	..	..	..	..	1 2	10,000,000 1,000,000	..	..	..	..	..		..	..	..	..	..		..	..
	Total of Chelsea Waterworks .	20,000,000	9,525,440	..	32,797	3,697	257,604	4	40	140,000,000	3	11,000,000	10	1,125	215	193	70	..	..	..	..	7	6¾	8' 0"	1¾	4

FROM THE FOREGOING EIGHT TABLES, GIVING THE PARTICULARS OF THE WORKS OF THE LONDON WATER COMPANIES FOR STORAGE, FILTRATION AND SUPPLY, IT WILL BE SEEN THAT THE GRAND TOTAL FOR THE METROPOLIS WAS AS FOLLOWS:—

Source of Supply and Intake.	Total Volume which may be supplied Daily. Gallons.	Average Daily Supply. Gallons.	Number of Supplies to Houses, &c., returned.	Number of Houses on constant Supply	Estimated population supplied within the Districts of the Water Companies.	Subsiding and Storage Reservoirs for Unfiltered Water.			Storage Filtered Water Covered Reservoirs within the Radius prescribed.		Engine Power.		Number of Miles of Mains.	Number of Miles of Mains in the Metropolis.	Number of Miles of Streets with Mains constantly charged within the Metropolis.	Number of Street Hydrants and private Fire-cocks erected within the Metropolis.	Filters.		
						No.	Area in Acres.	Available Capacity. Gallons.	No.	Capacity. Gallons.	No.	Horse Power					Filter Beds. No.	Filter Beds. Area in Acres.	No. of Acres of Filter Beds cleaned during the Month.
From Thames	110,000,000	70,643,108																	
Other Sources	Not restricted.	69,161,974																	
Grand Total for the Metropolis ..	..	139,805,082	668,525	258,205	4,944,553	54	465¼	1,290,100,000	53	160,002,000	149	17,145	4,068	2,948	927	6,724 hydrants.	96	97	60

CHAPTER VI.—QUALITY OF WATER AND WATER ANALYSES.

THE published Reports on the Analysis of the Waters supplied by the Metropolitan Water Companies during the year 1883, (1) by Professor Frankland, D.C.L., F.R.S., and (2) by Messrs. W. Crookes, F.R.S., W. Odling, M.B., F.R.S., F.R.C.P., and Dr. C. Meymott Tidy, M.B., F.C.S., give the best information obtainable respecting the quality of the London Water Supply.

These Reports may be regarded, on the principle of *ex uno disce omnes*, as typical of annual reports generally. That the authorities should not be altogether in accord in their views respecting the quality of the water supplied, is scarcely surprising when it is remembered that they have absolutely no recognised standard to guide them. It should not, however, be forgotten with regard to "organic impurity" that not only is the amount present in filtered Thames water infinitesimal in actual quantity, but we have the distinct opinion of the last Royal Commission on Water Supply—an opinion arrived at after hearing very varied and often contradictory evidence—that the presence of a small quantity of organic matter in drinking water is not necessarily prejudicial.

(1.) Professor Frankland reports:—"Since I first commenced the regular analysis of monthly samples of the London waters in 1865, important changes have taken place both on the banks of the rivers from which the greater part of the supply is derived and also in the works of the respective companies to whom that supply is entrusted. In the year 1865 all the large towns in the basins of the Thames and Lee which were provided with a sewerage system, freely discharged their raw sewage into these rivers or their tributaries, and as each year added to the number of such towns, the amount of untreated sewage gaining access to the rivers was an ever-increasing one. The water companies, on the other hand, being ill provided either with storage reservoirs or filtering appliances, were compelled to draw from the rivers in time of flood, and the water so drawn was not, by their treatment, rendered even clear and colourless to the eye. Under these circumstances it was not surprising that chemical analysis frequently discovered an excessive proportion of organic matter in the water delivered to consumers.

"In 1869 the Royal Commission on Water Supply, in summing up their conclusions as to the quality of the water supplied from the Thames basin, state:—'That when efficient measures are adopted for excluding the sewage and other pollutions from the Thames and the Lee, and their tributaries, and for ensuring perfect filtration, water taken from the present sources will be perfectly wholesome, and of suitable quality for the supply of the Metropolis.' Although there have been great improvements made in the disposal of the sewage of many of the larger towns since 1869, yet none of these improvements have taken the form of sewage exclusion. It is sewage-purification that has been attempted and not sewage-exclusion. Indeed the expense involved in carrying out any scheme for excluding the sewage from the rivers is so great as to render such a plan practically impossible. The methods adopted for cleansing the sewage of the principal towns in the Thames basin are chiefly the application of the sewage to land, either by way of irrigation or of intermittent downward filtration. In a few instances methods of chemical treatment are employed either alone or in conjunction with the first-named methods. Irrigation and intermittent downward filtration, when properly carried out, yield equally good results, whilst the various methods of chemical treatment effect comparatively little improvement in the sewage, excepting so far as the coarser matters in suspension are concerned. The adoption of these several methods of purification contributes greatly to improvement in the appearance and even the chemical quality of the river waters; yet it must not be forgotten that there is not one of these processes, even when carried out with the greatest care and efficiency, that offers any sort of guarantee against the admission into the Thames and Lee of noxious ingredients which may at any time be present in sewage, and which are capable of spreading zymotic disease. The chance of such morbific matter gaining access to the river waters is, by these processes of purification, no doubt diminished; but in the interests of the public health, the fact ought not to be ignored that there is at present no evidence whatever that these processes are effective either for the retention or destruction of zymotic poisons sometimes present in sewage. In the smaller towns and villages, comprising the greater portion of the population of the Thames basin, the sewage is generally allowed to collect in cesspits,. the overflow from which usually communicates with the nearest stream or watercourse, whilst in other cases the street drains are utilized for conveying the sewage matters into the nearest running water. It thus appears that, notwithstanding the improvements in the disposal of town-drainage, the river Thames still receives much raw sewage matter, together with the affluents from the sewage-works which have been constructed in many places. Indeed the task of banishing these and other objectionable pollutions from the river is an entirely hopeless one.

"In dealing with the raw material thus supplied to them, very great improvements have been effected by the water companies; these have consisted chiefly in an increased accommodation for storage and the construction of more efficient filtering appliances. The result of these improvements has been that water of much more uniform quality throughout the year, is now distributed, and that it is, in nearly all cases, clear and bright to the eye. Thus whilst in the year 1868, out of 84 samples of river water examined there were only 48 clear and transparent, in the past year there were, out of the same number of samples, no less than 73 clear and transparent. Moreover, of the 11 turbid samples in the past year, all were only 'slightly turbid,' and none 'very turbid' or 'turbid'; whilst in 1868 out of 36 turbid samples, 20 were 'slightly turbid,' 9 'turbid,' and 7 'very turbid.' The occurrence of moving organisms amongst the suspended matters of these turbid waters is now much rarer than formerly. Thus in the year 1869 these organisms were seen 24 times or in 80 per cent. of the turbid samples, whilst last year they have only been discovered on six occasions, or in 55 per cent. of the turbid samples.

"Nevertheless, in wet seasons, when the rivers are in protracted flood, the water distributed in London generally contains a very large proportion of organic matter; thus even as recently as 1880 the water supplied both from the Thames and the Lee contained a greater average proportion of organic matter than in any year since these analyses have been made. But even with the proportion of organic matter at its minimum there is no certainty that the water does not contain the germs of zymotic disease; for, as I have already stated, there is still no guarantee against such morbific matters gaining access to the rivers, and there is nothing in the subsequent treatment to which the river water is subjected by the companies that will ensure the removal of matters of this description. It has been recently shown, that filtration through far greater thicknesses of sand than could be employed on the large scale by water companies is quite insufficient to remove those lower forms of living matter which, in their habits, we have good reason to believe, simulate the organisms causing zymotic disease. Indeed I am informed that several of the water companies themselves are now impressed with the necessity of ultimately abandoning the rivers Thames and Lee as sources of water supply, and some of them have already completed works for utilizing subterranean waters which have undergone natural filtration through great thicknesses of gravel and sand, whilst others are sinking deep wells into the chalk. In the interest of the public health, it is to be hoped that works of this description will be continued and receive every encouragement.

"During the year 1883 the average daily volume of water supplied to the inner circle of the Metropolis by the eight companies, amounted to 144,592,772 gallons. Although this quantity is upwards of three millions of gallons in excess of the previous year, yet the average consumption per head of population was almost exactly the same, amounting to 28·4 gallons per day as against 28·6 in 1882. Of this total supply, 9,567,634 gallons from deep-wells in the chalk were of uniformly good quality throughout the year, whilst the remainder, consisting of 71,710,878 gallons from the Thames, and 63,314,260 gallons from the Lee, was open to the before-mentioned objections urged against the river waters. The samples analysed were in all cases taken directly from the mains at places recommended by the companies themselves.

"The temperature of each sample at the time of collection was observed, and its appearance in a two-foot tube has also been recorded; whilst in the case of those samples found to be more or less turbid the suspended matter deposited on standing was submitted to microscopical examination.

"In Table A the temperature of the waters as they issued from the companies' mains is recorded. In this respect the waters exhibited the following variations:—

"The Thames water distributed by the Chelsea, West Middlesex, Southwark, Grand Junction, and Lambeth Companies varied in temperature from 3·1° C. (37·6° Fahr.) in March to 22·0° C. (71·6° Fahr.) in July.

"The temperature of the water abstracted from the Lee and sent out by the New River and East London Companies showed a variation from 3·4° C. (38·1° Fahr.) in March to 20·0° C. (68·0°F ahr.) in July.

"The deep-well water of the Kent Company varied in temperature from 3·4° C. (38·1° Fahr.) in March, to 15·5° C. (59·9° Fahr.) in June.

" Thus the temperature of the river waters was subject to greater variation than that of the deep-well water, the latter remaining of an agreeable coolness in summer, when the river waters became warm and unpalatable.

" Table B shows the total amount of solid matters present in 100,000 parts by weight of each of the waters. A very large proportion of this solid matter consists of mineral salts, which are quite unobjectionable in drinking water, but as they render the water hard, they make it less suitable for washing and for most manufacturing purposes.

" A small proportion of this solid matter, on the other hand, is organic. Small quantities of vegetable organic matter are not objectionable in drinking water, but the organic matter in river water which receives sewage may at any time become dangerous to health. The greatest amount of total solid matters was found in the deep-well water supplied by the Kent Company and by the Tottenham Local Board of Health, whilst the Colne Valley Company's water, although derived from the same source, contained but little more than one-third of that amount, and little more than one-half of that present in any of the river waters. This reduction in the amount of solid matters present in the water of the Colne Valley Company is effected by the application of Clark's process of softening, which consists in adding to it a small quantity of slaked lime. The solid matters in the other Metropolitan waters would be reduced to about the same amount by similar treatment.

" Tables C and D record the proportion in which organic matter was present in the waters, as indicated by the amount of organic carbon and nitrogen found by combustion. The importance of these tables is obvious when it is remembered that the organic matter in the river water is, to no small extent, derived from animal sources, such as raw sewage, the effluent from sewage works, and the drainage from manured land. From these tables it will be seen that during an unusually large part of the year the amount of organic matter in the river waters was exceptionally small, although the difference between the quality of the water in summer and winter was still sufficiently marked. The deep-well water, on the other hand, was not only superior to the river waters, when at their best, but maintained its good quality throughout the year.

"Taking the mean proportion of organic impurity contained in the Thames water delivered in 1868 as 1000, I find that in the subsequent years, 1883 included, the following proportions were present :—

Year.	Proportion of organic impurity present in Thames water as delivered in London.
1868	1,000
1869	1,016
1870	795
1871	928
1872	1,243
1873	917
1874	933
1875	1,030
1876	903
1877	907
1878	1,056
1879	1,165
1880	1,254
1881	993
1882	1,033
1883	850

"It thus appears that in the past year, the water drawn from the Thames was of better average quality than in any previous year, excepting 1870, since these analyses have been made.

"The water drawn from the Lee and distributed by the New River and East London Companies was uniformly of better average quality than that from the Thames. The New River Company's supply was in every case superior to that of the East London Company.

"Taking, as before, the mean proportion of organic impurity in the Thames water supplied to London in 1868 as 1000, I find in that and the succeeding years, 1883 included, the following proportions in the Lee water delivered by the New River and East London Companies :—

Year.	Proportion of organic impurity present in Lee water as delivered in London.
1868	484
1869	618
1870	550
1871	604
1872	819
1873	693
1874	583
1875	751
1876	562
1877	596
1878	747
1879	947
1880	1,013
1881	765
1882	711
1883	620

"These figures show that during the past year the condition of the water supplied from the Lee was better than in any of the previous years since 1877.

"In the case of the deep-well waters supplied to London, the organic matter, when compared with the same standard, was :—

1868	254
1869	312
1870	246
1871	150
1872	221
1873	250
1874	287
1875	250
1876	246
1877	243
1878	323
1879	387
1880	393
1881	405
1882	409
1883	321

"The proportion of organic matter present in the deep-well waters was thus but little more than one-half that in the Lee, and considerably less than one-half of that in the Thames. The amount would have been still less but for extensive alterations which were being made at the works of the Tottenham Local Board of Health, in consequence of which the deep-well waters had to be supplemented by water obtained from the mains of the East London Company. The execution of such alterations in deep-wells, which are in active use, is attended with considerable danger to the consumers, as was demonstrated some years since at Caterham, where the excrements of a workman suffering from a slight attack of typhoid fever gained access to the well and were the means of simultaneously communicating this disease to a large number of persons both in Caterham and in the town of Red Hill some eight miles distant. In the interest of the public health, such alterations should be carried on under medical supervision.

"From a sanitary point of view the superiority of the deep-well over the river water is really much greater than a comparison of the above figures would indicate, for the thorough process of natural filtration, which the deep-well water has undergone in passing through a great thickness of porous strata, renders it extremely improbable that any of those suspended particles, which may become prejudicial to health, should have escaped removal.

"Unfortunately the protection from pollution, which is afforded by the common law to rivers, is at present denied to subterranean waters. That the latter may now be polluted to an unlimited extent without remedy was shown by the judgment of Mr. Justice Pearson in an action, Ballard *v.* Tomlinson, recently heard in the Court of Chancery. It is most desirable that these invaluable subterranean sources of pure water should be carefully protected by law.

"In Table E is recorded the proportional amount of organic elements (organic carbon and organic nitrogen) in each of the waters, the average amount of these elements contained in the Kent Company's water during the nine years ending December, 1876, being taken as unity. This Table shows that the maximum, minimum, and average proportions of organic matter, as measured by this standard, present in the several waters during 1883 were as follows:—

Sources.		Maximum.	Minimum.	Average.
Deep wells ..	Kent	1·5	0·9	1·1
	Colne Valley ..	1·5	1·0	1·2
	Tottenham	2·3	1·1	1·7
River Lee ..	New River	3·6	1·3	2·2
	East London ..	5·0	1·9	2·9
River Thames ..	Chelsea	4·7	2·0	3·1
	West Middlesex ..	5·7	2·0	3·7
	Southwark	6·6	1·9	3·6
	Grand Junction ..	5·3	2·4	3·4
	Lambeth	5·7	2·0	3·6

"These figures clearly illustrate that the deep-well waters remain of nearly uniform purity throughout the year, whilst the river waters, although exceptionally free from excessive pollution during the past year, exhibit very marked fluctuations. Of the deep-well water that supplied by the Kent Company was the best, whilst of the river water the New River Company's supply was the best, and that of the West Middlesex Company the worst, the Chelsea Company's supply ranking first amongst the Thames derived waters.

"The following Table shows the maximum amount of organic pollution in the waters supplied from the Thames and Lee during the years 1868 to 1883 inclusive, the average of the samples in the month of greatest pollution being taken for comparison:—

“ Maximum Amount of Organic Pollution.

Thames.			Lee.		
Year.	Elements of organic matter in parts per 100,000.	Months in which maximum pollution occurred.	Year.	Elements of organic matter in parts per 100,000.	Months in which maximum pollution occurred.
1868	·45	January.	1868	·27	February.
1869	·60	February.	1869	·33	February.
1870	·42	January.	1870	·30	January.
1871	·52	October.	1871	·22	February.
1872	·48	Jan. and Dec.	1872	·39	December.
1873	·46	January.	1873	·33	January.
1874	·37	March.	1874	·21	March.
1875	·49	November.	1875	·28	November.
1876	·44	December.	1876	·24	March.
1877	·40	January.	1877	·30	January.
1878	·36	December.	1878	·26	June.
1879	·38	February.	1879	·33	July.
1880	·42	October.	1880	·33	February.
1881	·34	February.	1881	·34	February.
1882	·37	November.	1882	·26	December.
1883	·32	January.	1883	·24	December.

“ Thus the waters, both from the Thames and the Lee, were during the past year exceptionally free from excessive pollution. The recent improvement in this respect is especially marked in the case of the Thames, and is to be attributed to the action of the Board of Conservators and to the greater storage capacity with which the companies drawing from this river are now provided, as already pointed out.

“ Tables F and G require no comment.

“ Table H records the total amount of combined nitrogen, which, after making a small deduction for the average quantity contained in rain water, constitutes the total evidence of both past and present contamination with nitrogenous organic matters which the waters have suffered. In river water, however, the quantity of total combined nitrogen is considerably reduced during the summer months by the presence of active vegetable and animal life, and it is, therefore, only in the autumn and winter months that it can be regarded as any measure of pollution. During the months of January, February, March, October, November, and December 1879, the average proportion of total combined nitrogen in 100,000 parts of Thames water was ·281 part, in 1880 ·276, ·260 in 1881, ·258 in 1882, and last year ·259 part. The continuous diminution, which has thus taken place, is doubtless due to the longer storage to which the water has in recent years been subjected.

"In the same quantity of water supplied during the same months from the Lee, the average total combined nitrogen was ·310 part in 1879, ·284 in 1880, ·294 in 1881, ·304 in 1882, and ·329 in last year. No diminution, but, on the contrary, rather an increase in the amount of total combined nitrogen has thus taken place.

"The deep-well water distributed by the Kent and Colne Valley Companies and by the Tottenham Local Board of Health is not subject to the influence of animal or vegetable life, and the average of the total combined nitrogen may therefore be taken on the whole year. In 1879 it was ·317 part, ·294 in 1880, ·306 in 1881, ·294 in 1882, and ·353 part last year.

"In Table I is recorded the proportion of chlorine present in each of the waters. The figures show that no brackish or tidal water gained access to the companies' reservoirs.

"Table K shows the hardness of the various waters. By hardness is to be understood the weight of carbonate of lime, or its equivalent of other soap-destroying substances, present in 100,000 parts of water.

"The average hardness of the Thames water delivered in London, was 20·8° in 1879, 20·2° in 1880, 19·8° in 1881, 20·7° in 1882, and 19·9° in 1883; of the Lee, 21·4° in 1879, 20·7° in 1880, 20·8° in 1881, 21·1° in 1882, and 20·6° in last year; of the Kent Company's water, 28·4° in 1879, 26·6° in 1880, 28·3° in 1881, 28·5° in 1882, and 28·0° in 1883; of the Colne Valley Company's water, 6·3° in 1879, 6·3° in 1880, 6·2° in 1881, 5·5° in 1882, and 7·1° in 1883; and of the water sent out by the Tottenham Local Board of Health, 25·6° in 1879, 22·2° in 1880, 24·1° in 1881, 25·4° in 1882, and 22·5° last year.

"Soft water is absolutely necessary for the washing of linen, and if the water be not naturally so, it has to be softened by means of carbonate of soda, or soap, before being employed for that purpose. This process of softening with soap in the laundry entails an expense about 80 times as great as when the same is done on the large scale by a water company. All the water delivered in London, excepting that of the Colne Valley Company, was unsuitable for washing. The water drawn by the Colne Valley Company from the chalk is naturally hard, but is rendered soft by means of Clark's process before distribution.

"Table L, lastly, records the average, for the past year, of each determination already specified, and thus summarizes the results of the analyses of the water supplied by each company during the year.

"The results of my observations respecting the efficiency of the filtration to which the waters of the Thames and Lee were subjected by the various companies during the past year are contained in the following Table:—

Companies or Local Authorities.	Number of occasions when clear and transparent.	Number of occasions when slightly turbid.	Number of occasions when turbid.	Number of occasions when very turbid.
THAMES.				
Chelsea	11	1	0	0
West Middlesex ..	11	1	0	0
Southwark ..	7	5	0	0
Grand Junction ..	9	3	0	0
Lambeth	11	1	0	0
LEE.				
New River ..	12	0	0	0
East London ..	12	0	0	0
DEEP WELLS.				
Kent	12	0	0	0
Colne Valley ..	12	0	0	0
Tottenham Local Board of Health	11	0	0	1

"Thus, of the river water, only that sent out by the

New River and East London Companies was uniformly clear.

"As already pointed out, nothing furnishes more conspicuous proof of the improvements which have been effected in the companies' works than the comparative freedom from turbidity which the river waters now exhibit.

"The deep-well water supplied by the Kent and Colne Valley Companies and by the Tottenham Local Board of Health is uniformly clear and bright, and requires no artificial filtration. The turbid sample of the Tottenham water was collected at a time when alterations were being made in the bore-hole, and is thus accounted for.

"The sediment deposited by the turbid waters on standing was in every case examined microscopically. During the past year these examinations revealed the presence of moving organisms in no less than three samples of the Southwark Company's water, whilst one sample of the Chelsea, Grand Junction, and Lambeth Companies' waters respectively exhibited the same phenomenon, as did also the turbid sample of the Tottenham water.

"In the following Table the results of these microscopic examinations, made during the past 15 years, are collected:—

NUMBER of Occasions when MOVING ORGANISMS were found.

——	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.
Chelsea	3	2	2	3	2	5	4	4	1	0	2	0	0	0	1
West Middlesex	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0
Southwark ..	8	1	4	1	2	5	5	7	5	3	0	0	0	0	3
Grand Junction	4	1	1	2	3	5	7	3	3	3	1	3	3	0	1
Lambeth ..	5	0	4	6	3	4	5	4	1	1	0	2	1	1	1
New River ..	0	0	0	0	1	1	0	0	1	0	0	2	0	0	0
East London ..	4	3	3	1	0	2	0	0	0	0	2	0	0	1	0
Kent	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Colne Valley ..	–	–	–	–	–	–	–	–	0	0	0	0	0	0	0
Tottenham ..	–	–	–	–	–	–	–	–	0	0	0	0	0	0	1

TABLE A.

TEMPERATURE (IN CENTIGRADE DEGREES) OF THE METROPOLITAN WATERS, AS DELIVERED FROM THE DIFFERENT COMPANIES' MAINS.

	Companies or Local Authorities.	1883.												
		Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Inner Circle.	THAMES.													
	Chelsea	8·7	7·4	4·8	10·4	15·2	16·1	17·7	17·0	16·0	13·4	9·0	7·7	11·9
	West Middlesex	9·1	6·8	4·8	12·1	13·2	19·4	22·0	19·5	18·2	13·6	7·3	6·6	12·7
	Southwark	9·1	6·4	4·0	12·4	18·0	18·0	22·0	19·8	18·1	14·0	7·6	5·8	12·9
	Grand Junction	8·0	6·2	3·5	11·5	12·4	18·0	20·8	18·8	17·5	13·0	11·1	5·5	12·2
	Lambeth	8·5	7·0	3·1	10·9	16·0	16·6	20·0	18·2	16·9	12·7	6·7	4·9	11·8
	LEE.													
	New River	8·8	5·9	4·9	10·7	11·0	18·3	20·0	18·0	17·2	13·0	6·8	6·7	11·8
	East London	8·0	5·8	3·4	11·0	11·2	17·9	19·5	18·3	17·3	12·9	6·4	5·1	11·4
	DEEP WELLS.													
	Kent	6·8	7·2	3·4	14·1	15·0	15·5	14·5	15·2	15·0	14·4	12·0	12·5	12·1
Outer Circle.	Colne Valley	11·1	..	..	..	..	..	..	..	..	..	..	..	..
	Tottenham Local Board	..	..	..	..	..	..	..	..	16·0	..	..	..	..

TABLE B.

WEIGHT OF SOLID MATTERS IN 100,000 PARTS OF THE WATERS.

	Companies or Local Authorities.	1883.												
		Jan.	Feb.	March.	April.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Inner Circle.	THAMES.													
	Chelsea . . .	31·16	29·58	27·84	25·92	24·56	24·20	26·34	24·80	25·62	26·20	29·04	30·14	27·12
	West Middlesex .	29·68	29·60	29·62	25·96	26·32	25·60	24·92	24·78	25·66	27·72	31·10	32·14	27·76
	Southwark . .	28·94	27·92	30·64	27·58	25·18	26·12	26·70	25·94	26·00	29·22	32·36	32·08	28·22
	Grand Junction .	30·08	28·80	30·30	27·30	28·06	25·62	26·46	25·42	25·54	24·36	32·16	32·80	28·07
	Lambeth . . .	30·14	30·20	32·10	28·98	28·46	27·20	27·48	25·94	27·76	30·72	30·84	32·82	29·39
	LEE.													
	New River . .	31·68	33·16	30·44	26·56	25·12	25·48	26·50	25·38	26·44	28·58	31·02	31·40	28·48
	East London . .	36·50	34·86	32·32	26·62	27·54	26·28	27·70	27·02	23·58	30·46	33·18	35·42	30·12
	DEEP WELLS.													
	Kent	44·86	46·16	43·00	38·78	40·04	39·72	43·86	40·26	38·40	38·68	43·44	43·30	41·71
Outer Circle.	Colne Valley . .	14·96	17·30	16·30	14·90	12·96	16·26	27·62	14·12	12·98	13·30	12·70	13·28	15·56
	Tottenham Local Board . . .	41·14	46·00	43·70	38·00	37·00	36·40	36·12	36·70	37·62	41·52	37·34	36·92	39·04

TABLE C.

ORGANIC CARBON IN 100,000 PARTS OF THE WATERS.

	Companies or Local Authorities	1883.												
		Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Inner Circle.	THAMES.													
	Chelsea . . .	·228	·239	·207	·111	·104	·122	·101	·123	·102	·170	·169	·194	·156
	West Middlesex .	·284	·288	·206	·111	·144	·119	·109	·124	·105	·215	·224	·285	·184
	Southwark . .	·347	·257	·115	·097	·145	·141	·161	·124	·127	·222	·223	·247	·184
	Grand Junction .	·271	·231	·118	·108	·123	·127	·123	·137	·124	·174	·187	·242	·164
	Lambeth . . .	·264	·290	·123	·110	·171	·134	·153	·135	·102	·209	·258	·263	·184
	LEE.													
	New River . .	·168	·182	·120	·080	·104	·066	·071	·078	·057	·086	·114	·151	·106
	East London . .	·192	·201	·160	·095	·148	·099	·092	·121	·111	·136	·160	·267	·148
	DEEP WELLS.													
	Kent	·069	·053	·040	·054	·043	·050	·048	·042	·040	·037	·057	·062	·050
Outer Circle.	Colne Valley . .	·070	·049	·056	·058	·046	·048	·043	·047	·047	·054	·059	·055	·053
	Tottenham Local Board . . .	·081	·081	·077	·059	·076	·112	·042	·065	·069	·100	·074	·084	·077

TABLE D.

ORGANIC NITROGEN IN 100,000 PARTS OF THE WATERS.

Companies or Local Authorities.		1883.												
		Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Inner Circle.	THAMES.													
	Chelsea . . .	·033	·041	·050	·032	·021	·019	·027	·032	·018	·025	·024	·040	·030
	West Middlesex .	·044	·048	·043	·030	·032	·014	·019	·020	·015	·031	·051	·046	·033
	Southwark . .	·042	·050	·024	·016	·041	·019	·031	·016	·020	·024	·026	·041	·029
	Grand Junction .	·043	·044	·034	·038	·031	·017	·031	·021	·027	·060	·023	·039	·034
	Lambeth . . .	·027	·049	·032	·038	·041	·021	·020	·018	·019	·026	·029	·038	·030
	LEE.													
	New River . .	·033	·030	·028	·020	·021	·013	·019	·017	·018	·017	·014	·025	·021
	East London . .	·036	·034	·020	·019	·024	·014	·024	·020	·026	·036	·020	·030	·025
	DEEP WELLS.													
	Kent	·019	·016	·016	·015	·012	·015	·017	·017	·016	·017	·006	·010	·015
Outer Circle.	Colne Valley . .	·019	·022	·019	·010	·011	·014	·019	·019	·010	·014	·021	·020	·016
	Tottenham Local Board . . .	·026	·028	·023	·008	·042	·022	·023	·017	·010	·023	·018	·027	·022

TABLE E.

PROPORTIONAL AMOUNT OF ORGANIC ELEMENTS, THAT IN THE KENT COMPANY'S WATER DURING THE NINE YEARS ENDING DECEMBER 1876 BEING TAKEN AS 1.

	Companies or Local Authorities,	1883.												
		Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Inner Circle.	THAMES.													
	Chelsea . . .	4·4	4·7	4·3	2·4	2·1	2·4	2·2	2·6	2·0	3·3	3·3	4·0	3·1
	West Middlesex .	5·5	5·7	4·2	2·4	3·0	2·2	2·2	2·4	2·0	4·2	4·7	5·6	3·7
	Southwark . .	6·6	5·2	2·3	1·9	3·2	2·7	3·2	2·4	2·5	4·2	4·2	4·9	3·6
	Grand Junction .	5·3	4·7	2·6	2·5	2·6	2·4	2·6	2·7	2·6	4·0	3·6	4·8	3·4
	Lambeth . . .	4·9	5·7	2·6	2·5	3·6	2·6	2·9	2·6	2·0	4·0	4·9	5·1	3·6
	LEE.													
	New River . .	3·4	3·6	2·5	1·7	2·1	1·3	1·5	1·6	1·3	1·7	2·2	3·0	2·2
	East London . .	3·9	4·0	3·1	1·9	2·9	1·9	1·9	2·4	2·3	2·9	3·1	5·0	2·9
	DEEP WELLS.													
	Kent	1·5	1·2	0·9	1·2	0·9	1·1	1·1	1·0	0·9	0·9	1·1	1·2	1·1
Outer Circle.	Colne Valley . .	1·5	1·2	1·3	1·2	1·0	1·1	1·1	1·1	1·0	1·1	1·4	1·3	1·2
	Tottenham Local Board . . .	1·8	1·8	1·7	1·1	2·0	2·3	1·1	1·4	1·3	2·1	1·6	1·9	1·7

TABLE F.

Ammonia in 100,000 parts of the Waters.

	Companies or Local Authorities.	1883.												
		Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Inner Circle.	**Thames.**													
	Chelsea . . .	0	·001	0	0	0	0	0	·001	0	·001	0	0	0
	West Middlesex .	0	0	0	0	0	0	0	0	0	0	0	0	0
	Southwark . .	0	0	0	0	0	0	0	0	0	0	0	0	0
	Grand Junction .	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lambeth . . .	0	0	0	0	0	0	0	0	0	0	0	0	0
	Lee.													
	New River . .	0	0	0	0	0	0	0	0	0	0	0	0	0
	East London . .	0	0	0	0	0	0	0	0	0	0	0	0	0
	Deep Wells.													
	Kent	0	0	0	0	0	0	0	0	0	0	0	0	0
Outer Circle.	Colne Valley . .	0	0	0	0	0	0	0	0	·002	0	·001	·010	·001
	Tottenham Local Board . . .	·065	·048	·050	·055	·050	·060	·050	·075	0	·030	·060	·055	·050

TABLE G.

NITROGEN AS NITRATES AND NITRITES IN 100,000 PARTS OF THE WATERS.

	Companies or Local Authorities.	1883.												
		Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Inner Circle.	THAMES.													
	Chelsea . . .	·199	·212	·214	·236	·181	·170	·196	·142	·156	·184	·206	·221	·193
	West Middlesex .	·245	·227	·264	·244	·236	·175	·172	·157	·168	·148	·217	·216	·206
	Southwark . .	·186	·194	·329	·210	·196	·175	·160	·169	·163	·222	·262	·231	·206
	Grand Junction .	·141	·177	·309	·241	·207	·180	·169	·172	·179	·123	·227	·258	·199
	Lambeth . . .	·179	·204	·394	·269	·249	·205	·197	·190	·209	·237	·218	·234	·232
	LEE.													
	New River . .	·339	·312	·375	·294	·243	·192	·194	·188	·210	·255	·292	·288	·265
	East London . .	·308	·312	·320	·241	·227	·183	·185	·155	·137	·251	·259	·304	·240
	DEEP WELLS.													
	Kent	·514	·469	·376	·393	·465	·521	·477	·532	·473	·420	·473	·523	·470
Outer Circle.	Colne Valley . .	·467	·565	·548	·527	·496	·406	·384	·368	·371	·351	·376	·411	·439
	Tottenham Local Board . . .	0	0	0	0	0	0	0	0	·303	·378	0	0	·057

TABLE H.

TOTAL COMBINED NITROGEN IN 100,000 PARTS OF THE WATERS.

	Companies or Local Authorities.	1883.												
		Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Inner Circle.	THAMES.													
	Chelsea . . .	·232	·254	·264	·268	·202	·189	·223	·175	·174	·210	·230	·261	·223
	West Middlesex .	·289	·275	·307	·274	·268	·189	·191	·177	·183	·179	·268	·262	·238
	Southwark . .	·228	·244	·353	·226	·237	·194	·191	·183	·183	·246	·258	·272	·235
	Grand Junction .	·184	·221	·343	·279	·238	·197	·200	·193	·206	·183	·250	·297	·233
	Lambeth , . .	·206	·253	·426	·307	·290	·226	·217	·208	·228	·263	·247	·272	·262
	LEE.													
	New River . .	·372	·342	·403	·314	·264	·205	·213	·205	·228	·272	·306	·313	·286
	East London . .	·344	·346	·340	·260	·251	·197	·209	·175	·163	·287	·279	·334	·265
	DEEP WELLS.													
	Kent	·533	·485	·392	·408	·477	·536	·494	·549	·489	·437	·479	·533	·484
Outer Circle.	Colne Valley . .	·485	·587	·567	·537	·507	·420	·403	·387	·383	·365	·398	·439	·456
	Tottenham Local Board . . .	·080	·067	·064	·055	·083	·071	·064	·079	·313	·426	·067	·072	·120

TABLE I.

CHLORINE IN 100,000 PARTS OF THE WATERS.

	Companies or Local Authorities.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
		1883.												
Inner Circle.	THAMES.													
	Chelsea	1·6	1·5	1·4	1·5	1·6	1·5	1·5	1·6	1·6	1·6	1·6	1·5	1·5
	West Middlesex	1·5	1·5	1·4	1·5	1·7	1·6	1·5	1·5	1·5	1·5	1·5	1·5	1·5
	Southwark	1·5	1·4	1·5	1·5	1·7	1·5	1·5	1·6	1·6	1·5	1·5	1·5	1·5
	Grand Junction	1·5	1·5	1·5	1·5	1·7	1·5	1·5	1·6	1·5	1·5	1·5	1·5	1·5
	Lambeth	1·6	1·7	1·6	1·5	1·7	1·5	1·5	1·6	1·5	1·5	1·5	1·5	1·6
	LEE.													
	New River	1·7	1·7	1·6	1·6	1·6	1·5	1·6	1·6	1·5	1·5	1·6	1·7	1·6
	East London	1·9	1·8	1·7	1·7	1·8	1·7	1·7	1·7	1·7	1·6	1·8	1·7	1·7
	DEEP WELLS.													
	Kent	2·6	2·6	2·5	2·4	2·7	2·6	2·7	2·9	2·4	2·5	2·4	2·5	2·6
Outer Circle.	Colne Valley	1·7	1·8	1·8	1·8	1·8	1·7	1·8	1·7	1·7	1·6	1·7	1·7	1·7
	Tottenham Local Board	3·0	3·1	3·1	2·6	2·5	2·5	2·4	2·4	2·7	2·8	2·5	2·5	2·7

TABLE K.

DEGREES OF HARDNESS (1 DEG. = 1 PART OF CARBONATE OF LIME, OR ITS EQUIVALENT) IN 100,000 PARTS OF THE WATERS.

	Companies or Local Authorities.	1883.												
		Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Inner Circle.	THAMES.													
	Chelsea . . .	20·6	20·0	19·4	18·0	16·9	18·9	19·1	18·9	18·0	18·6	20·3	20·6	19·1
	West Middlesex .	20·3	19·1	20·6	17·7	18·9	20·0	18·6	19·1	19·4	19·7	21·5	22·1	19·7
	Southwark . .	19·1	18·9	21·5	19·4	18·0	19·7	19·7	19·1	20·0	20·9	22·4	22·1	20·1
	Grand Junction .	20·3	18·6	21·2	18·6	18·6	20·0	19·4	19·4	18·9	18·3	22·4	22·7	19·9
	Lambeth . . .	20·6	19·1	21·2	20·0	19·4	20·9	20·6	19·4	20·3	21·8	21·5	22·7	20·6
	LEE.													
	New River . .	21·2	20·9	21·2	18·6	18·6	20·3	20·3	18·9	19·7	20·6	22·1	22·1	20·4
	East London . .	22·7	22·4	22·4	18·0	19·1	20·3	19·7	19·4	17·4	21·8	22·7	24·2	20·8
	DEEP WELLS.													
	Kent	29·3	27·8	26·4	24·3	26·4	28·5	30·7	29·3	27·1	27·8	27·9	30·0	28·0
Outer Circle.	Colne Valley . .	5·7	6·6	6·6	5·6	5·7	8·6	20·3	4·6	5·7	5·6	5·1	5·1	7·1
	Tottenham Local Board . . .	24·3	22·8	27·1	23·5	25·0	22·8	22·8	26·4	21·4	22·1	17·1	15·2	22·5

TABLE L.—AVERAGES FOR 1883.

THE NUMBERS IN THIS TABLE RELATE TO 100,000 PARTS OF EACH WATER.

	Companies or Local Authorities.	Temperature in Centigrade Degrees.	Total Solid Matters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen, as Nitrates and Nitrites.	Total combined Nitrogen.	Chlorine.	Total Hardness.	Proportional Amount of Organic Elements, that, in the Kent Company's Water during the nine years ending Dec. 1876 being taken as 1.
Inner Circle.	THAMES.	°									
	Chelsea	11·9	27·12	·156	·030	·000	·193	·223	1·5	19·1	3·1
	West Middlesex	12·7	27·76	·184	·033	0	·206	·238	1·5	19·7	3·7
	Southwark	12·9	28·22	·184	·029	0	·206	·235	1·5	20·1	3·6
	Grand Junction	12·2	28·07	·164	·034	0	·199	·233	1·5	19·9	3·4
	Lambeth	11·8	29·39	·184	·030	0	·232	·262	1·6	20·6	3·6
	LEE.										
	New River	11·8	28·48	·106	·021	0	·265	·286	1·6	20·4	2·2
	East London	11·4	30·12	·148	·025	0	·240	·265	1·7	20·8	2·9
	DEEP WELLS.										
	Kent	12·1	41·71	·050	·015	0	·470	·484	2·6	28·0	1·1
Outer Circle.	Colne Valley	—	15·56	·053	·016	·001	·439	·456	1·7	7·1	1·2
	Tottenham Local Board	—	39·04	·077	·022	·050	·057	·120	2·7	22·5	1·7

NOTE.—The numbers in these tables may be converted into grains per imperial gallon, by multiplying them by 7, and then moving the decimal point one place to the left

(2). The Report on the composition and quality of daily samples of water supplied to London during the year 1883, by Messrs. Crookes, Odling, and C. Meymott Tidy, is addressed to the Official Water Examiner for the Metropolis. From this report the following extracts are given, some passages being omitted which partake more particularly of a controversial character, and do not appear to afford any direct information on the main elements of the question :—

"We submit a statement of the general results of our examination, made at the expense of the water companies, of the 2,224 samples of water collected by us during the year 1883, from the mains and reservoirs of the seven London companies taking their supply from the Thames and the Lee.

"We may mention that from the time of commencing our monthly reports in December, 1880, we have, up to December, 1883, examined and reported on 6,524 samples of the water supplied to the metropolis.

"COLOUR OF THE WATER.—In a tabulated form will be found* recorded the results of our daily examinations of the colour exhibited by the water supplied by the several companies, as estimated by the colour meter, the construction and use of which we have fully described in our previous reports. These results are represented diagrammatically in the wave diagrams which are placed at the end of this report.

"The use of a coloured glass wedge for comparing an unknown with a known tint of colour, and for assigning to the former its true place on a graduated scale, is probably as old as quantitative analysis itself. The use of a hollow wedge, filled with coloured solution, also dates from comparatively early days, and was used in 1857 by Dr. J. H. Gladstone, in his researches on the use of the prism in qualitative analysis. We ourselves have used the hollow wedge in colorimetric experiments for more than twenty years, and in adopting two wedges, one opposed to the other, and filled respectively with blue and with brown liquid, so as almost exactly to imitate the varying tints of potable water, we considered we were justified, in 1881, in characterising the process as 'a great improvement over the arbitrary degrees of tint-depth by which the colour of water has hitherto been estimated.' and in 1882, as 'a great improvement on all previous means (so far as we know them) for obtaining a standard of colour.' In our annual report on the composition and quality of the London waters for 1882, we drew further attention to this colour-meter, as showing a close relationship between the organic carbon present and the colour of the water, saying that 'the relationship thus exhibited goes far to establish the usefulness of the colorimetric mode of examination introduced and employed by ourselves, and its value as an improvement on the rougher methods still in common use.'

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* *See* Note to p. 74.

"Our attention has lately been drawn by Professor Albert R. Leeds, of the Stevens Institute of Technology, Hoboken, New Jersey, United States, to a prior publication by him of a colorimeter, in the 'Journal of the American Chemical Society,' and in the 'Chemical News' for June 7, 1878. This consisted of one wedge filled with standard caramel solution, and capable of being moved in and out beneath flat-bottomed cylinders. In so far as Professor Leeds used the varying thickness of a standard brown solution in a hollow wedge to fix numerically the tint of water, he anticipated the method we employ, although in some points of detail, and in the principle of using two wedges filled each with a differently coloured liquid, corresponding to each of the two main contributory tints of potable water, our method differs from his. At the time of our devising the colorimeter we have since employed, we were unaware of what had been done by Professor Leeds; with whose request to us to make this explanation, recognising his claim to priority in the use of a hollow wedge colorimeter for the purpose of water examination, we willingly comply.

"In our colorimeter, the tint of colour, exhibited by a thickness of two feet of the water under examination, is compared with the conjoint tint of so many millimetres of a particular blue solution, and of so many millimetres of a particular brown solution,—both solutions being coloured with definite mineral salts, and made of a specific strength, so as to be reproducible of exactly the same shade and depth of tint after any interval of time. As a general rule, the degree of brownish tint in the same supply of water is found to vary with the proportion of organic matter present in the water, as determined by the combustion process, and by the permanganate process. This is shown very strikingly in what we have called the mean Thames-water curves, as plotted for the past three years, 1881–83. (See Table, p. 67.) But to this general rule, occasional exceptions are presented by individual samples of water, doubtless because the fluviatile conditions affecting the constituent colorific organic matter of the water and its entire organic matter, are not identical, and because the effect of filtration upon the constituent and the entirety are also not identical.

"CLEARNESS.—We still continue the use of the phrases 'turbid,' 'slightly turbid,' 'very slightly turbid,' and 'clear.' The special meaning we attach to these arbitrary terms has been explained in our previous reports.

"The results of our examination, in respect to their state of clearness, of the 2,224 samples collected by us during the year, are duly arranged and tabulated.

"Summarising the results, we note that thirty-two samples were recorded as very slightly turbid (V. S. T.), and five as slightly turbid (S. T.), while 2,187 samples out of the 2,224 were found to be perfectly bright, clear, and well filtered. In three out of the five samples recorded as slightly turbid, the turbidity was confined to the locality from which the samples were drawn, and was dependent on the carrying out of work at the time, in connection with the supply of the neighbourhood.

"The proportion of samples found to be bright, clear, and well filtered, amounted to 91·4 per cent. in 1881; to 97·6 per cent. in 1882; and to 98·3 per cent. during the past year.

"FREE OXYGEN.—This we have recorded in cubic inches per gallon; practically, the water has been found throughout the year to be fully aërated or oxygenated. Our own experiments, conducted now for a period of three years at the rate of about 180 a month, constitute the first consecutive series of determinations of the state of aëration of potable water hitherto carried out. Other chemists are gradually getting to recognise the value of the results afforded, and to make use of the process of free oxygen determination in their study of questions relating to water supply, and to the remarkable self-purifying power of running water, now become more than ever a matter of positive demonstration. Even, however, in 1869, the Royal Commission on Water Supply felt themselves warranted in making the following statement:—'This purifying process is not a mere theoretical speculation; we have abundant practical evidence, which we shall hereafter refer to, of its real action on the Thames and other rivers.' Two of ourselves have of late been engaged, independently of each other, in the examination of this question, and a series of experiments under the charge of one of us is still in progress. In our next annual report we hope to give a summary of our results.

"AMMONIA AND ORGANIC MATTER.--In a tabulated form will be found recorded the quantities of free or saline ammonia present in the 318 samples of water examined. It is noteworthy that on two occasions the $\frac{1}{333}$rd of a grain per gallon, and on five occasions the $\frac{1}{500}$th of a grain per gallon were recorded. On 48 occasions the $\frac{1}{1000}$th of a grain per gallon were recorded; while 263 examinations revealed no appreciable trace of ammonia whatsoever. The proportion of samples free from recognisable ammonia amounted, in 1881, to 60·6 per cent. of the whole; in 1882, to 70·9 per cent. of the whole; and during the past year, 1883, to 82·7 per cent. of the whole.

"The actual organic matter present has been estimated by the oxygen process, and by combustion. In estimating the oxygen required, we have adopted the method described in detail by one of our number in the 'Journal of the Chemical Society' (Vol. XXXV., p. 46, 1879): while in the combustion process we have followed the lines laid down by Frankland and Armstrong. The oxygen required to oxidize the organic matter has been estimated in seven samples daily, viz., a sample from each company's supply, and our results are summarised and arranged in our tables. The organic carbon and nitrogen have been estimated in one sample daily, and our results are also given in a table. We have in this table given also, in a companion column, the quantities of oxygen necessary to oxidize the organic matter in the same samples.

"As in our previous Annual Reports, we have appended curve diagrams, showing, in the case of each company's water, the general similarity manifested by the variations observed in the course of the year, in respect to the three items of 'organic carbon,' 'oxygen absorbed,' and 'brown tint of colour.' In another sheet we have given an additional set of curves, showing the variation in respect to the same three items undergone by what we may call mean Thames water. The three continuous curves given in this additional sheet—those for 'organic carbon' and 'oxygen absorbed' being for the three years, 1881, 1882, and 1883, and that for 'brown tint of colour' being for the last two years, 1882 and 1883 only—are the calculated mean results afforded by our examination of the water supplied by the five companies, namely, the Chelsea, West Middlesex, Lambeth, Grand Junction, and Southwark and Vauxhall Companies, taking their supply from the Thames. In these mean curves the parallelism in the variations recorded, with regard to the items in question, is more striking than in the curves giving the variations in the same items as observed in the case of the water of only one company. A glance at these continuous mean curves reveals the further fact of a successive gradual yearly diminution in the small proportion of organic matter present in the Thames-derived water supplied to the Metropolis. We have reason to think that this diminution is dependent to a considerable extent on the continuously increased efforts made by the Water Companies to improve the filtration and subsidence processes and arrangements.

The mean height of curve for each item in the several consecutive years is given in the following table :—

——	1881.	1882.	1883.
Organic Carbon . . .	0·180	0·160	0·143
Oxygen absorbed . .	0·053	0·055	0·041
Brown tint of colour .	..	21·6	17·0

"NITROGEN (AS NITRATES AND NITRITES) AND CHLORINE.—These have been estimated in daily samples of the waters, and the results are stated in our tables. The quantity of nitrogen, in the form of nitrate or nitrite, ranges from about 0·150 to 0·225 of a grain per gallon, the quantity being on the average somewhat lower in the summer and autumn than in the winter and spring quarters. Adding together the nitrogen in the form of ammonia, that in the form of organic matter, and that in the form of nitrates and nitrites, we get the total combined nitrogen of the water; from the quantity of which Dr. Frankland calculates what he calls the "previous sewage contamination" of the water, amounting in the case of the river supply of London to about one-third of that met with in the spring water supply. The quantity of chlorine amounts throughout the year to either close upon, or a little over, one grain per gallon, corresponding to about one and three-quarters of a grain per gallon of common salt.

"HARDNESS.—The degree of hardness has been estimated in a daily sample of the water, and our results are given in a table.

"The mineral matter in solution consists mainly of the carbonates of the alkaline earths, with a small quantity of sulphates, nitrates and chlorides. These salts, there is reason to believe, are beneficial rather than prejudicial to the animal economy, supplying, as they do, constituents required for the organism.

"GENERAL OBSERVATIONS.—From time to time, in our successive monthly reports, and more especially in some of those made during the past year, 1883, we have had occasion to animadvert on the . . . reports on the water supply of the metropolis addressed to the Registrar-General, and published by him in the first number for the month of his well-known 'Weekly Returns.' We make it no reproach to the distinguished chemist responsible for these reports that he should entertain a strong objection to the river sources from which, by authority of the Legislature, and after full inquiry by Parliamentary Committees and Royal Commissions, upwards of ninety per cent. of the water supply of London is at the present time derived. In common with all who know him, we recognise his great attainments and his deservedly high scientific position. We admit, moreover, his possession of special qualifications entitling him to form, in respect to London water supply, his own independent opinion, adverse though it may be to the conclusions arrived at by the several tribunals before whom authoritative inquiries on the subject have from time to time been held. . . . To the actual analytical results set forth in his reports we do not in general take exception. . . . Despite, however, the occurrence of occasional discrepancies, to which we have not hesitated to call attention at the time, the general results of the two sets of analyses, his and ours, agree fairly well, making allowance for the fact that our samples for complete analysis are collected one on every day throughout the year, excluding Sundays and holidays; while the samples reported on by him to the Registrar-General are collected all on a single day in every month. Taking the two sets of estimations of organic carbon as an example, our own mean results for the year 1883, in grains per gallon, are given in the first column, those reported to the Registrar-General in the second column, and the differences, ranging only from six- to sixteen-thousandths of a grain per gallon, in the third column of the underneath table:—

Mean Results, 1883.	Organic Carbon.		Differences.
	Grains per gallon.		Grains per gallon.
New River Company . .	0·059	0·069	0·010
East London Company .	0·088	0·094	0·006
Thames Companies . .	0·099	0·115	0·016
	C. O. & T.	Frankland.	

"The difference in the two sets of results, even in the case of the Thames Companies' water, where it is largest, is admittedly of no practical consequence. Thus, calculating from the mean proportions of organic carbon, as given above, the mean quantity of organic matter present in the Thames-derived supply of London, for 1883, would, according to our results, just fall short of, and according to the other results would slightly exceed, a quarter of a grain per gallon ; a quantity so small as to render its absolute excess of one-tenth of a grain per gallon beyond the mean quantity present in the New River Company's supply, a matter of no consideration. It is not then to Dr. Frankland's actual results, and certainly not to his general results, that we take constant exception. We do, however, protest most strongly against the peculiar modes of statement and comparison employed by him, with obvious intent to disparage the river-water supply, and exalt the well-water supply of the metropolis. . . .

"It was explained in the report of the Royal Commission on Water Supply, that a minute proportion of organic matter, variable in amount with season, is a normal constituent of river water; that there is no reason whatever to consider this proportion of natural organic matter as in any way prejudicial to health ; and that there is absolutely no chemical evidence to indicate that the minute proportion of organic matter present in the water supply of London is different, either in quantity or kind, from the natural organic matter of the river, as met with, for instance, at Lechlade, where the main stream of the Thames is formed. Of the typical varieties of water other than river water, resorted to for town supply, lake water is characterised, by containing, for the most part, about the same small proportion of organic matter that is present in river water ; while good spring water is characterised by containing a considerably smaller proportion of organic matter than either river water or lake water, and at the same time of containing a considerably higher proportion of total nitrogen ; . . . let us see what is implied in the statement . . . that the amount of organic impurity contained in individual samples of Metropolitan water is two, three, or four times as large as a particular average amount present in the Kent Company's water; and consider further, what is the basis of fact on which this statement reposes. In the first place, the statement clearly implies that spring water is the proper type of what river water, or at any rate of what Metropolitan water should be,—a notion entirely without foundation . . . It further suggests the notion that the wholesomeness and desirableness of different water supplies are inversely as the ascertained quantities of organic matter which they respectively contain—that a water containing two-tenths of a grain of organic matter per gallon is twice as unwholesome as a water containing only one-tenth, and a water containing one-tenth twice as unwholesome as a water containing only one-twentieth of a grain—and this irrespective of any ascertainment of the chemical nature and hygienic character of the organic matter, and irrespective of any regard to the absolute smallness, one might almost say insignificance, of even the largest quantities habitually met with. If the statement has not this implied meaning, it would seem, as we take it, to have no meaning at all. With a view to show what are the facts of the matter, we have made an abstract of the monthly results published in the Registrar-General's returns for the past year 1883, in respect to the quantities of organic carbon present in the water supplies of London, Birmingham, and Glasgow; these results, so far as London is concerned, being, as we have already pointed out, fairly in accordance with, though somewhat higher than our own.

"The following Table shows the actual quantities of organic carbon, expressed both in parts per 100,000 and in grains per gallon, and the estimated quantities of organic matter in grains per gallon, present in the several supplies of water, as determined by monthly analyses of the London waters made by Dr. Frankland, of the Birmingham water made by Dr. Hills, and of the Glasgow water made by Dr. Mills. For the calculations giving the figures in the second and third columns of the Table, we are responsible.

“Means of Monthly Analyses, 1883.

Source.	Proprietary.	Organic Carbon.		Organic Matter.
		Parts per 100,000.	Grains per gallon.	Grains per gallon estimated.
Chalk Springs	Kent Company . . .	0·050	0·035	0·087
River Lee, and Springs .	New River Company .	0·099	0·069	0·173
River Lee .	East London Company	0·135	0·094	0·235
Loch Katrine	Glasgow Corporation .	0·143	0·100	0·250
Mixed . .	Birmingham Corporation	0·148	0·103	0·259
River Thames	The Five Companies .	0·164	0·115	0·287

“It will be seen that the organic matter of the Kent Company's spring water is under one-tenth of a grain per gallon; that the organic matter of the New River Company's water, which is to the extent of about four-fifths river water and one-fifth spring water, is considerably under two-tenths of a grain per gallon; that the organic matter of the East London Company's water, which is a river water, that of the Glasgow Corporation's water, which is a lake water, and that of the Birmingham Corporation's water, which is a mixed water, supplied in varying proportions from reservoir, stream, and well, are alike about two-and-a-half-tenths, *i.e.* a quarter of a grain per gallon; while the organic matter of the Thames companies' supply of river water is under three-tenths of a grain per gallon. It is to be noted, however, that, although the average proportion of organic matter in the Thames-derived water supplied to London is, to the extent of three- or four-hundredths of a grain per gallon, in excess of that in the Birmingham and Glasgow Corporations' supplies, this excess is entirely due to the effect of the winter floods. Comparing the results for the eight months, March to October, 1883, the proportion of organic matter in the Glasgow Corporation's supply, or 0·247 grain per gallon, is somewhat in excess of the proportion found in the Thames supply, or 0·224 grain per gallon. In view of the importance which is sometimes attached, though, as we maintain unwarrantably, to the relative variations in the always minute proportion of organic matter present in the London supply, it is satisfactory to note that at periods of summer-heat and drought, the natural agencies at work to keep down the proportion of organic matter existing in the water of the river, are at their maximum of activity. It results, in this way, that the water supply of London is at its best at those seasons of the year when any failure in the quality of the supply might be considered likely to be of exceptionally serious import.

"The above statements, as to the particular fractions of a grain of dissolved organic matter present in a gallon of different kinds of water, serve to convey some idea of the habitual exceeding smallness of the quantity. Whether or not variations—it may be relatively large, but always falling within the limit of a very small absolute quantity per gallon—are matters of any real significance, must obviously depend on the character of the dissolved organic matter present in the different waters, or in the same water at different times. We are not unmindful of the predominant importance of this consideration; and should any charges be made impugning the wholesomeness of London water by reason of the ascertained nature of the small proportion of organic matter which it is found to contain, we shall, as we believe, be prepared to meet these charges; or undoubtedly, failing this, to admit them. But it is not from the results of any experimental investigation, as to the nature and influence of the small proportion of organic matter present in London water, that its wholesomeness is month after month by suggestion attacked. Neither is it, save in the case of a few samples collected at periods of flood, that any charge of unwholesomeness is preferred against the water by reason of the absolute quantity, or increase of quantity, of organic matter which it contains."

Note.—The author regrets that the limited space at his disposal is insufficient to admit of the numerous most interesting Tables and Diagrams which accompanied Messrs. Crookes, Odling, and Tidy's Report being inserted here. They will be found *in extenso* in the published Report.

PART II.

HISTORY AND DESCRIPTION

OF THE

LONDON WATERWORKS.

I.—THE KENT WATERWORKS.

THE Company of the Proprietors of the Kent Waterworks obtained incorporation by an Act of Parliament passed in 1809, to supply the parishes of St. Nicholas and St. Paul's Deptford; St. Alphage, Greenwich; St. Margaret, Lee; St. Mary, Lewisham; and St. Mary, Rotherhithe.

1701.—The Act empowered the Company to purchase the works and privileges of the Ravensbourne Water Works, established under royal letters patent, granted by King William the Third in the thirteenth year of his reign, for the exclusive supply of the royal manors of Sayes Court and East Greenwich, for a term of five hundred years, from the River Ravensbourne and elsewhere.

1809.—The Ravensbourne Works consisted of pumping machinery driven by a water wheel, and designed by the celebrated engineer, Smeaton, by which the water from the Ravensbourne was distributed through wooden pipes.

1811.—In 1811 the Company entered into an arrangement with the Town Commissioners of Woolwich to supply that town with water, and purchased from the Commissioners a pumping engine, together with a lease from Sir T. M. Wilson, of certain springs in the parish of Charlton, from whence it was proposed to supply the town of Woolwich. The Company thereupon applied to Parliament, and obtained a second Act, which confirmed the agreement with the Woolwich Commissioners, and extended the Company's water limits so as to include the parishes and places of St. Mary, Woolwich ; St. Nicholas, Plumstead ; St. Luke, Charlton ; St. Mary Magdalen, Bermondsey ; and, Peckham and Peckham Rye in the parish of St. Giles, Camberwell ; it also empowered them to raise a further sum of £100,000, making the total capital £250,000.

1812–1824.—The Company, acting under the advice of their consulting engineer, Mr. John Rennie, erected a pair of steam pumping engines, made by Messrs. Boulton & Watt (which are still working), and proceeded to lay down iron water mains for the supply of the district, which included the Royal Dockyards and other Government establishments at Woolwich and Deptford.

1844.—A filter bed was constructed, and the district was supplied with filtered water.

1850.—The Company obtained Parliamentary powers to raise a further sum of £100,000, which was expended in extending their mains, and in improving the Deptford Works, by the erection of a pair of 70-inch diameter cylinder Cornish pumping engines, and the construction of additional filter-beds and subsiding reservoir.

1857.—The Company sunk their first deep well in the chalk, at Deptford, which yielded an abundant supply of excellent water.

1861.—In this year the Plumstead, Woolwich and Charlton Consumers' Pure Water Company were wound up in Bankruptcy, and the works were sold by auction ; they were purchased by the freeholder, Mr. Lewis Davis, who subsequently sold them to the Kent Company.

1862.—The Company obtained an Act of Parliament, with power to increase their capital to £525,000, and having been successful in obtaining further supplies from the chalk, entirely abandoned the supply of water from the river Ravensbourne.

1864.—In this year the Company obtained an Act of Parliament to amalgamate with their undertaking the North Kent Waterworks Company, incorporated by an Act of Parliament in 1860, to supply water to the parishes of Dartford, Bexley, East Wickham, Erith, Eltham, Chislehurst and Bromley, from the River Stoneham at Crayford, but the Act was in abeyance, no works having been executed. By this Amalgamating Act the authorised capital was raised to £750,000.

1867.—The Company commenced the supply of their North Kent District, from deep wells in chalk at Shortlands and Crayford.

1868.—The Company purchased the water works of the Dartford Local Board of Health, which were constructed in 1854, but which had never been used, the Local Board having allowed their creditors to seize and sell the pumping engine on the completion of the works. In this case the Local Board obtained Parliamentary sanction for the sale of their water works to the Kent Company.

1877.—The Company, on the invitation of the Bromley Rural Sanitary Authority, applied to Parliament, and obtained powers to supply water to the Cray Valley, and the adjacent parishes, viz., Stone, Swanscombe, Darenth, Wilmington, Sutton-at-Hone, Farningham, Eynsford, North Cray, Foots Cray, St. Paul's Cray, St. Mary Cray, Orpington, Chelsfield, Farnborough, Keston, West Wickham, Hayes, and Shortlands in the parish of Beckenham. By this Act the Company's authorized capital was raised to £950,000.

1880.—The company obtained a further supply of water from a deep well sunk in the chalk in the parish of Farnborough, for the supply of their new district in the Cray Valley.

The Kent Waterworks Company have six pumping stations, situate at the following places :

Deptford.
Plumstead.
Crayford.

Shortlands.
Dover Road, Shooter's Hill.
Farnborough.

And eleven covered reservoirs, situate as under :—

Deptford, 2.
New Cross, 1.
Woolwich Common, 1.
Plumstead Common, 2.
Shooter's Hill, 1.
Greenwich Park, 1.
Chislehurst, 1.
Farnborough, 1
Dartford, 1.

The Company have entirely abandoned the supply from the River Ravensbourne, and the water is obtained wholly from deep wells in the chalk, sunk at five of their pumping stations.

The following is a description of the Company's works :—

Deptford.—The most important station is Deptford, situated on the banks of the River Ravensbourne.

There are three wells at this station, and eight pumping engines of 858 horse-power. Three of these engines are employed in lifting water from the wells, and the remainder in forcing it into the mains for the supply of the district. There are two covered reservoirs, with a joint capacity of 2,000,000 gallons. The other buildings consist of offices, cottages, workshops, stores, &c.

Plumstead.—This station has one well sunk in the chalk, and one engine of 63 horse-power, with cottage for man in charge ; there are also three reservoirs, each capable of containing 200,000 gallons, which were formerly used as depositing reservoirs in connection with Dr. Clark's process for softening chalk water, which was first practically tested here, upwards of a quarter of a century ago. The apparatus which was designed to soften the water by means of cream of lime became choked with the precipitated chalk, and the process was ultimately abandoned.

Crayford.—At this station there are three wells, and three pumping engines of 186 horse-power, and a cottage for the man in charge.

Shortlands.—At this station there are two wells sunk into the chalk, and two engines of 93 horse-power, with cottage for man in charge.

Shooter's Hill.—At Dover Road, Shooter's Hill, there are a pair of horizontal engines of 47 horse-power, used for forcing the water from the Woolwich Common reservoir to the top of Shooter's Hill, and cottage for man in charge.

Farnborough.—At this station there is one well sunk in the chalk, and one engine of 120 horse-power, but the buildings are designed to contain a duplicate engine. There is a cottage for the man in charge.

New Cross.—Covered reservoir, constructed in 1874, on the top of Telegraph Hill, at an elevation of 160 feet above Ordnance datum ; it contains 1,750,000 gallons.

Woolwich Common.—Covered reservoir, containing 1,500,000 gallons, at an elevation of 250 feet above Ordnance datum.

Plumstead Common.—Two covered reservoirs, containing 850,000 gallons, at an altitude of 170 feet above Ordnance datum.

Shooter's Hill.—Covered reservoir on Constitution Hill, containing 300,000 gallons, at an altitude of 320 feet above Ordnance datum.

Greenwich Park.—A circular covered reservoir, containing 1,125,000 gallons, at an altitude of 158 feet above Ordnance datum.

Chislehurst.—A covered reservoir, containing 450,000 gallons, at an altitude of 315 feet above Ordnance datum.

Farnborough.—A covered reservoir, containing 1,400,000 gallons, at an altitude of 440 feet above Ordnance datum.

Dartford.—A circular covered reservoir, containing 370,000 gallons, at an altitude of 135 feet above Ordnance datum.

Further statistical details relating to this Company's Works will be found in *Statistics of Supply*, *Table No.* 1 (*ante*, page 38), and concerning its Capital, Income, Expenditure, and Profits, in *Table No.* 1A appended.

A map is also appended, shewing the parliamentary boundaries of the company, the position of the principal works and direction of the mains, the district supplied, and the area under constant supply, which are distinguished by different shadings.

As the water supplied by the Kent Company is taken wholly from the chalk, some information is subjoined (see Tables, pp. 81–86) as to its character, being analyses made by Dr. Albert J. Bernays, the analyst to the Company. The water is stated to be clear and almost free from matter of organic origin ; of a perfectly blue colour when regarded in mass, of an even temperature, and pleasantly cool throughout the hot days of summer. The residue on evaporation is white, and does not change colour on ignition.

THE KENT WATER WORKS COMPANY.

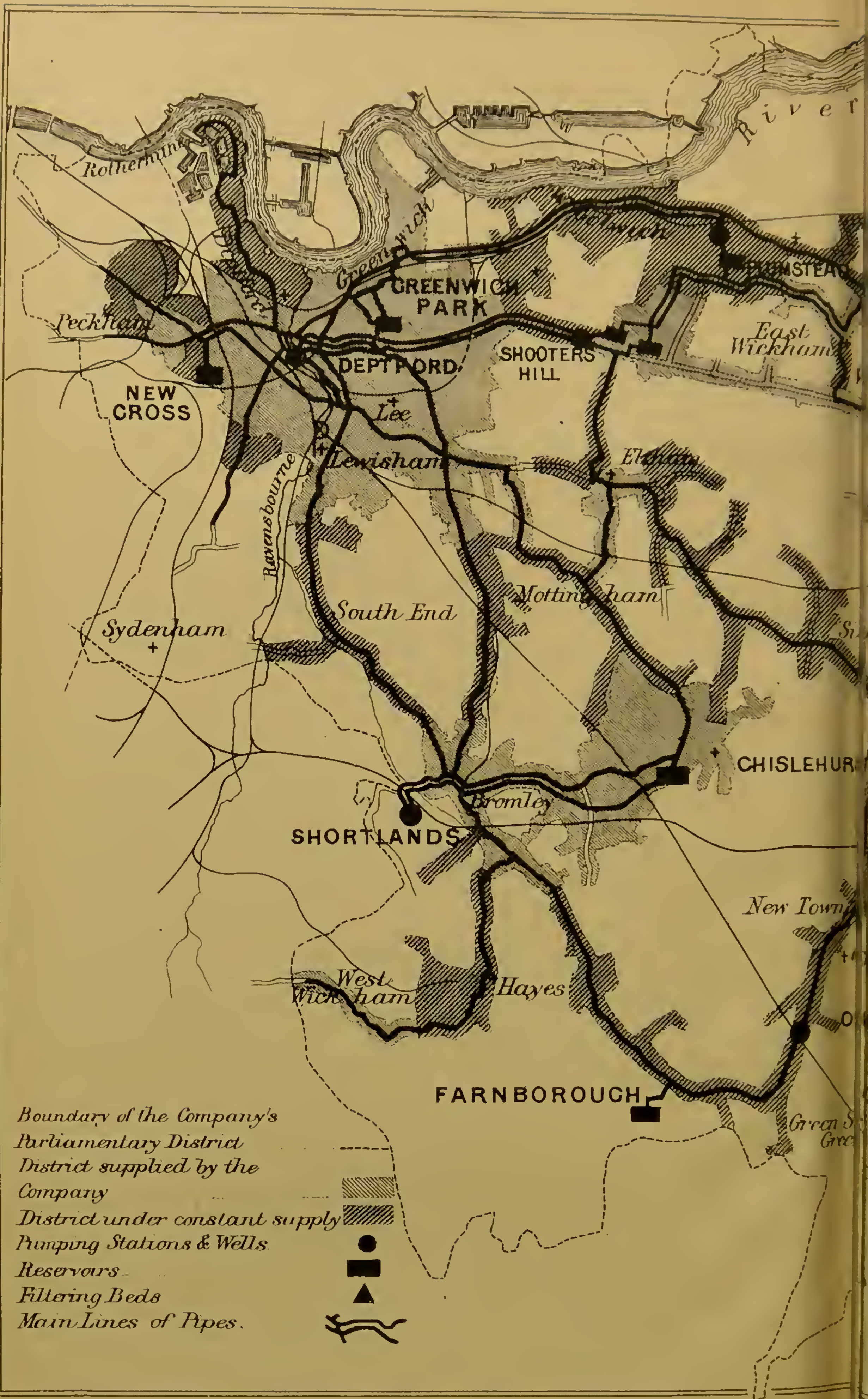
TABLE No. 1A.—Statement shewing the Capital authorised, raised and expended at the end of each year, together with the Income, Expenditure on Maintenance and Management, Profit on Trading, Interest paid, Net Profit, Dividends paid, &c., for each year, during a period of ten years.

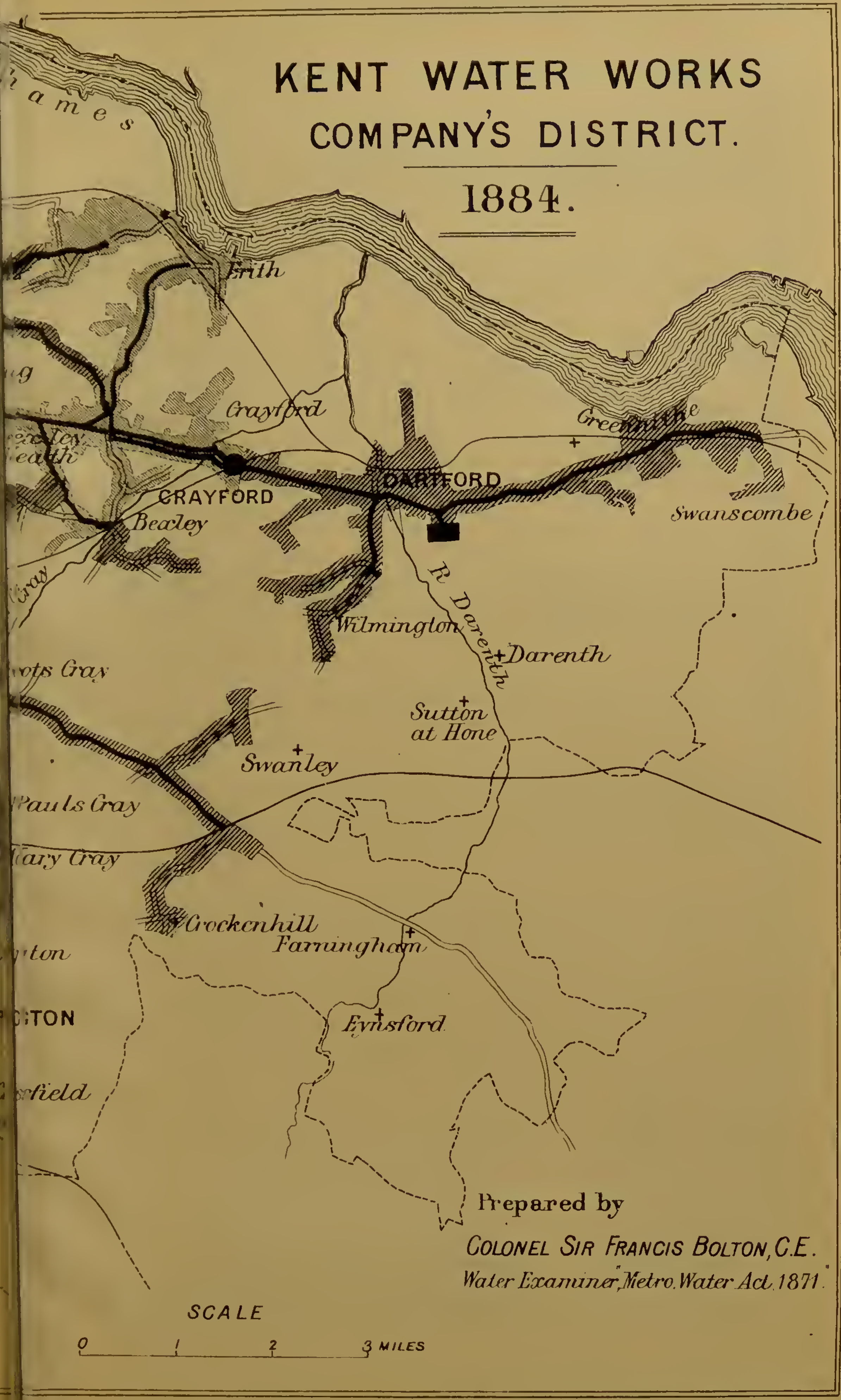
Prepared (in connection with the International Health Exhibition of 1884) *for the Diagrams of* COLONEL SIR FRANCIS BOLTON, C.E., *Water Examiner under the "Metropolis Water Act,* 1871," *by* ALFRED LASS, F.C.A.

For Year ending	CAPITAL AUTHORISED, RAISED, AND EXPENDED (at the end of each Year).												INCOME.				
	Share and Loan Capital authorised.	SHARE AND LOAN CAPITAL RAISED AND PREMIUMS RECEIVED.						Balance of Authorised Capital remaining to be raised.	CAPITAL EXPENDED AND EMPLOYED.				Gross Water Rents.	Less Empty Houses and Bad Debts, &c.	Net Water Rents.	Miscellaneous Receipts (Rents of Lands, &c.)	Total Income.
		Ordinary Stocks and Shares.	Preference Stock.	Bonds and Debentures.	Total Share and Loan Capital raised.	Premiums received	Total Share and Loan Capital raised and Premiums received.		Capital expended.	Capital in Hand or Overdrawn.		Capital employed.					
										In Hand.	Overdrawn.						
31st December,	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1873	750,000	547,960	...	42,000	589,960	3,321	593,281	160,040	584,814	8,467	...	593,281	68,183 15 10	4,361 11 10	63,822 4 0	356 15 6	64,178 19 6
1874	750,000	555,180	...	42,000	597,180	5,567	602,747	152,820	602,316	431	...	602,747	71,247 13 0	3,809 13 8	67,437 19 4	107 2 6	67,545 1 10
1875	750,000	565,340	...	42,000	607,340	5,567	612,907	142,660	611,195	1,712	...	612,907	73,400 5 8	3,448 19 9	69,951 5 11	105 19 6	70,057 5 5
1876	750,000	575,497	...	42,000	617,497	5,567	623,064	132,503	618,017	5,047	...	623,064	77,103 12 4	2,959 14 0	74,143 18 4	118 0 6	74,261 18 10
1877	950,000	594,255 14,334	...	42,000	650,589	5,567	656,156	299,411	638,501	17,655	...	656,156	80,547 9 2	2,770 14 8	77,776 14 6	152 18 6	77,929 13 0
1878	950,000	621,840	...	42,000	663,840	5,567	669,407	286,160	664,293	5,114	...	669,407	84,284 6 11	3,000 13 6	81,283 13 5	153 0 6	81,436 13 11
1879	950,000	626,849	...	42,000	668,849	5,567	674,416	281,151	690,554	...	16,138	690,554	89,623 8 8	3,511 0 8	86,112 8 0	174 9 0	86,286 17 0
1880	950,000	663,163	...	42,000	705,163	5,567	710,730	244,837	704,739	5,991	...	710,730	94,351 18 0	4,126 5 6	90,225 12 6	186 17 0	90,412 9 6
1881	950,000	672,200	...	42,000	714,200	5,567	719,767	235,800	715,444	4,323	...	719,767	101,159 11 5	4,885 5 5	96,274 6 0	144 17 6	96,419 3 6
1882	950,000	687,075	...	42,000	729,075	5,567	734,642	220,925	725,802	8,840	...	734,642	106,291 11 5	5,827 15 1	100,463 16 4	235 17 9	100,699 14 1
Total . .	...	...	...	...	...	...	...	...	...	...	...		846,193 12 5	38,701 14 1	807,491 18 4	1,735 18 3	809,227 16 7

For Year ending	EXPENDITURE ON MAINTENANCE.										EXPENDITURE ON MANAGEMENT.									
	Maintenance of Reservoirs and Works for Storing Water.	Maintenance of Mains and Works connected with Distribution.	Pumping and Engine Charges.	Filtration.	Salaries of Engineers, Clerks and Inspectors, and Wages of Turncocks, &c.	Rents.	Abstraction of Water, &c.	Rates and Taxes.	Compensations, Premises and Mills; Superannuations and Law Expenses connected with Maintenance	Total Maintenance.	Directors	Company's Auditors.	Secretary, Accountant, and Clerks.	Superannuation, &c.	Collectors.	General Establishment Charges, Stationery, Printing, &c.	Law and Parliamentary.	Official Auditor and Water Examiner.	Total Management.
31st December,	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.		£. s. d.		£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1873	166 3 1	2,709 11 9	13,011 7 2	...	2,597 6 6	351 10 0	...	3,727 16 3	...	22,563 14 9	1,518 15 0	60 15 0	651 9 3	80 0 0	2,183 14 5	563 4 1	307 11 0	59 8 8	5,424 17 5
1874	243 16 6	2,212 10 1	12,129 6 7	...	2,487 12 8	351 10 0	...	4,051 14 9	...	21,476 10 7	1,512 10 0	60 10 0	609 0 10	80 0 0	2,441 15 6	573 4 0	1,425 2 0	59 16 11	6,761 19 3
1875	202 13 6	1,714 0 11	8,508 6 10	...	2,052 6 0	351 10 0	...	3,594 5 8	...	16,423 2 11	1,512 10 0	60 10 0	686 0 2	80 0 0	2,058 10 10	564 8 10	43 7 8	66 17 3	5,072 4 9
1876	212 13 6	2,127 17 0	8,895 19 6	...	2,238 7 8	351 10 0	...	4,060 14 5	..	17,887 2 1	2,008 6 8	90 7 6	785 17 11	80 0 0	2,119 16 9	657 12 7	414 2 7	66 4 7	6,222 8 7
1877	618 16 1	2,616 14 1	8,377 12 5	...	2,291 3 10	351 10 0	...	4,270 3 4	...	18,525 19 9	2,000 0 0	90 0 0	907 17 6	106 0 0	2,218 0 1	654 15 10	188 15 7	65 14 2	6,231 3 2
1878	302 3 11	2,478 1 3	9,026 13 7	...	2,382 6 0	351 10 0	...	4,146 19 5	...	18,687 14 2	2,000 0 0	90 0 0	1,119 6 0	198 12 0	2,297 17 2	703 15 3	576 0 0	65 1 6	7,050 11 11
1879	261 15 1	2,594 19 4	9,802 17 11	...	2,267 7 2	351 10 0	...	4,072 16 1	...	19,351 5 7	2,000 0 0	90 0 0	1,163 10 0	363 1 0	2,468 9 8	657 9 11	574 12 1	68 8 6	7,385 11 2
1880	267 0 7	2,362 18 7	9,218 10 3	...	2,890 11 11	342 10 0	...	4,309 18 6	...	19,391 9 10	2,000 0 0	90 0 0	1,482 12 6	444 6 0	2,397 15 2	774 6 5	58 14 11	68 6 4	7,316 1 4
1881	276 10 5	3,380 11 6	10,232 1 9	...	2,910 18 2	339 10 0	...	4,996 14 8	...	22,136 6 6	2,000 0 0	90 0 0	1,508 12 6	354 16 0	2,482 18 9	734 10 3	211 3 0	70 0 3	7,452 0 9
1882	253 13 5	2,668 2 4	10,035 9 2	...	3,029 10 1	360 11 0	...	5,019 7 7	...	21,386 13 7	2,000 0 0	90 0 0	1,569 11 7	204 16 0	2,602 15 1	693 6 9	63 14 10	78 18 3	7,303 2 6
Total . .	2,805 6 1	24,885 6 10	99,238 5 2	...	25,147 10 0	3,503 1 0	...	42,250 10 8	...	197,829 19 9	18,552 1 8	812 2 6	10,483 18 3	1,991 11 0	23,271 13 5	6,576 13 11	3,863 3 8	668 16 5	66,220 0 10

For Year ending	Total Maintenance and Management.	Profit on Trading.	Deduct Interest paid on Preference and Debenture Stocks and Loans, less Interest on Deposits, &c., received.	Net Profit.	Dividends paid.	Surplus.	Deficiency.	Contingency or Reserve Fund.	
								Taken from	Carried to
31st December,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1873	27,988 12 2	36,190 7 4	1,028 1 2	35,162 6 2	32,969 12 9	2,192 13 5	.	1,500 0 0	500 0 0
1874	28,238 9 10	39,306 12 0	1,395 10 8	37,911 1 4	35,914 4 4	1,996 17 0	..	1,422 14 11	...
1875	21,495 7 8	48,561 17 9	1,488 19 7	47,072 18 2	38,862 12 0	8,210 6 2	..	...	1,000 0 0
1876	24,109 10 8	50,152 8 2	1,138 6 3	49,014 1 11	45,227 4 0	3,786 17 11	.	558 4 10	1,000 0 0
1877	24,757 2 11	53,172 10 1	1,356 7 6	51,816 2 7	46,039 16 0	5,776 6 7	...	200 19 9	1,000 0 0
1878	25,738 6 1	55,698 7 10	610 15 9	55,087 12 1	51,091 10 6 6,164 19 8	...	2,168 18 1	...	1,000 0 0
1879	26,736 16 9	59,550 0 3	1,367 15 0	58,182 5 3	54,409 14 2	3,772 11 1	...	354 13 7	500 0 0
1880	26,707 11 2	63,704 18 4	1,237 8 11	62,467 9 5	57,579 4 10	4,888 4 7	...	...	500 0 0
1881	29,588 7 3	66,830 16 3	933 9 10	65,897 6 5	64,660 5 1	1,237 1 4	...	...	350 0 0
1882	28,689 16 1	72,009 18 0	817 9 7	71,192 8 5	67,339 5 0	3,853 3 5	...	...	1,505 3 10
Total	264,059 0 7	545,177 16 0	11,374 4 3	533,802 11 0	500,258 8 4	35,714 1 6	2,168 18 1	4,036 13 1	7,355 3 10


River
Rotherhithe
Greenwich
GREENWICH PARK
PLUMSTEA
Peckham
NEW CROSS
DEPTFORD
SHOOTERS HILL
East Wickham
Lee
Lewisham
Eltham
Ravensbourne
Mottingham
South End
Sydenham
CHISLEHUR
Bromley
SHORTLANDS
New Town
West Wickham
Hayes
FARNBOROUGH
Green S
Boundary of the Company's Parliamentary District
District supplied by the Company ▨
District under constant supply ▨
Pumping Stations & Wells ●
Reservoirs ■
Filtering Beds ▲
Main Lines of Pipes



KENT WATER WORKS COMPANY'S DISTRICT.

1884.

Prepared by

COLONEL SIR FRANCIS BOLTON, C.E.

"Water Examiner," Metro. Water Act, 1871.

James Wyld, 11 & 12 Charing Cross, London

DR. BERNAY'S ANALYSES.

	In terms of grains per gallon.			
	Crayford. Oct. 7, 1878.	Bath Well. Oct. 7, 1878.	Garden Well. June 26, 1878.	Shortlands. July 15, 1878.
Sodium chloride	1·20	2·73	1·50	1·51
Sodium sulphate	..	0·27	..	..
Potassium sulphate	1·11	1·23	0·17	0·12
Calcium chloride	0·68	..	0·15	0·30
Calcium sulphate	0·66	1·26	9·11	2·45
Calcium nitrate	..	..	..	0·58
Calcium carbonate	16·62	18·55	15·41	15·82
Magnesium nitrate	1·74	1·84	2·17	0·85
Magnesium carbonate	..	0·44	4·30	..
Silica	1·23	1·19	1·11	0·95
	23·24	27·51	33·92	22·58
Residue by analysis	22·96	26·92	33·12	23·27
Hardness before boiling	17·60	20·30	20·27	16·28
Hardness after boiling	2·80	5·40	6·97	7·72
Free ammonia	None	None	0·0016	None
Albuminoid ammonia	None	None	0·0078	0·002

DR. BERNAY'S ANALYSES.

Place.	Date.	Total solids.	Chlorine.	Free ammonia.	Albuminoid ammonia.	Total hardness.	Permanent hardness.	Oxydized nitrogen.	Organic carbon.	Organic nitrogen.
Bath Well, Deptford . .	October 15, 1877 .	28·966	1·540	0·0014	0·0039	19·990	6·700	0·403	0·049	0·009
Bath Well	January 7, 1878. .	28·950	1·740	0·0003	0·0046	19·340	4·930	0·358	0·020	0·005
Ditto	February 23, 1878 .	28·070	1·480	0·0007	0·0025	20·640	4·880	0·339	0·024	0·010
Ditto	May 17, 1878 . .	29·200	1·780	None	0·0041	18·510	7·160	0·302	0·023	0·006
Ditto	October 25, 1878 .	26·920	1·660	None	None	20·300	5·440	0·347	0·015	0·003
Ditto	March 25, 1879 . .	27·500	1·480	0·0007	0·0028	20·300	4·950	0·393	0·018	0·003
Ditto	July 26, 1879 . .	28·800	1·660	None	0·0010	19·600	5·250	0·393	0·043	0·008
Ditto	February 13, 1880 .	28·800	1·620	0·0008	0·0018	19·600	6.100	0·351	0·037	0·006
Ditto	May 19, 1880 . .	27·510	1·440	None	0·0007	19·800	4·900	0·297	0·024	0·009
Ditto	September 2, 1880 .	27·960	1·570	None	0·0007	19·210	5·170	0·328	0·024	0·006
Ditto	January 3, 1881 . .	29·120	1·480	None	None	20·300	6·400	0·309	0·024	0·007
Ditto	September 1, 1881 .	27·790	1·700	None	0·0014	19·800	6·600	0·260	0·019	0·007
Ditto	April 1, 1882 . .	28·210	1·570	None	None	19·800	5·900	0·328	0·026	0·0077
Ditto	December 1, 1882 .	29·750	1·540	0·0004	0·0013	20·200	7·550	0·367	0·030	0·007
Ditto	August 1, 1883 . .	28·560	1·700	0·0006	0·0025	19·500	6·400	0·412	0·029	0·004
Ditto	March 11, 1884 . .	28·980	1·530	None	0·0021	18·800	5·900	0·372	0·035	0·011
Crayford	April 11, 1877 . .	25·730	1·360	0·0003	0·0011	15·990	2·230	0·427		
Ditto	January 2, 1878. .	24·330	1·317	0·0003	0·0022	17·860	3·487	0·346	0·042	0·009
Crayford, No. 2. . . .	February 23, 1878 .	22·620	1·150	0·0004	0·0052	16·740	3·860	0·320	0·024	0·006
Ditto, No. 1. . . .	February 23, 1878 .	26·850	1·230	0·0001	0·0006	17·480	4·140	0·358	0·015	0·003
Ditto	September 7, 1878 .	23·900	1·270	None	0·0007	18·600	5.600	0·379	0·012	0·003
Crayford, No. 2. . . .	September 7, 1878 .	23·170	1·440	None	None	18·300	6·100	0·330	0·010	0·002
Crayford	October 7, 1878. .	22·960	1·170	None	None	17·600	2·800	0·329		
Crayford, No. 1. . . .	February 28, 1879 .	23·280	1·110	0·0006	0·0013	18·400	3·300	0·372	0·013	0·003
Crayford, No. 2. . . .	April 25, 1879 . .	23·590	1·190	0·0006	0.001	19·300	3·500	0·365	0·020	0·003
Ditto	November 21, 1879.	23·590	1·120	0·0004	0·0011	18·300	3·400	0·348	0·030	0·009
Ditto	June 4, 1880. . .	22·540	1·180	None	0·0014	18·300	3·100	0·322	0·029	0·006
Crayford	April 1, 1881 . .	23·030	1·440	0·0011	0·0007	18·300	3·650	0·357	0·024	0·003
Ditto	January 5, 1882. .	23·380	1·110	None	0·0011	18·700	4·400	0·340	0·019	0·0024
Ditto	October 3, 1882. .	24·500	1·190	None	0·0017	18·000	2·900	0·365	0·027	0·0077
Ditto	February 3, 1883 .	23·800	1·400	0·0007	0·0014	18·600	3·800	0·335	0·029	0·009
Ditto	October 1, 83 . .	24·500	1·190	0·0010	0·0015	17·900	3·450	0·380	0·020	0·006
Garden Well, Deptford .	May 22, 1877 . .	30·198	1·440	0·0003	0·0014	19·900	6·800	0·311		

Garden Well, Deptford .	November 12, 1877.	31·164	1·680	0·0001	0·0021	20·000	6·880	0·326	0·073	0·014
Ditto . .	February 23, 1878 .	29·060	1·480	0·0011	0·0055	18·510	7·720	0·294	0·024	0·012
Ditto . .	November 4, 1878 .	30·870	1·480	0·0001	0·0003	21·000	6·150	0·421	0·051	0·010
Ditto . .	June 7, 1879. . .	32·160	1·620	None	0·0010	19·900	6·600	0·379	0·033	0·008
Ditto . .	October 3, 1879. .	32·900	1·480	0·0001	0·0013	21·100	7·500	0·349	0·034	0·010
Ditto . .	March 24, 1880 . .	29·890	1·740	None	0·0003	22·100	6·200	0·294	0·034	0·011
Ditto . .	October 1, 1880. .	30·590	1·420	None	0·0010	20·900	6·400	0·293	0·034	0·006
Ditto . .	July 4, 1881 . . .	32·410	1·530	None	0·0014	21·000	7·100	0·325	0·030	0·004
Ditto . .	January 31, 1882 .	33·390	1·440	None	0·0010	22·300	7·750	0·331	0·019	0·005
Ditto . .	November 1, 1882 .	30·310	1·570	None	0·0021	22·500	6·900	0·260	0·028	0·0035
Ditto . .	June 1, 1883. . .	30·590	1·400	None	0·0006	20·800	6·650	0·323	0·033	0·010
Ditto . .	February 1, 1884 .	30·100	1·570	0·0006	0·0028	19·800	6·400	0·308	0·041	0·013
Orpington	August 25, 1880 .	21·660	0·980	0·0011	0·0017	17·200	4·850	0·498	0·038	0·013
Ditto	December 1, 1880 .	21·070	1·060	None	0·0014	18·600	4·700	0·477	0·027	0·003
Ditto	July 30, 1881 . .	22·330	0·930	0·0007	0·0011	17·110	4·400	0·467	0·015	0·002
Ditto	May 1, 1882. . .	23·380	0·980	None	0.0008	18·400	3·400	0·489	0·031	0·003
Ditto	January 1, 1883. .	22·260	0·980	None	0·0020	17·300	3·150	0·449	0·030	0·0056
Ditto	September 3, 1883 .	21·280	0·980	0·0007	0·0010	17·800	4·900	0.480	0.017	0·0050
Ditto	April 1, 1884 . .	23·380	0·930	0·0007	0·0046	17·000	2·500	0·410	0·040	0·0012
Shortlands, Old	July 15, 1878 . .	23·270	1·106	None	0·0011	16·460	7·720	0·259	0·019	0·006
Ditto, New . . .	September 4, 1879 .	21·420	1·020	0·0001	0·0010	17·500	3·850	0·232	0·024	0·003
Ditto . . .	May 7, 1880. . .	21·280	0·980	0·0007	0·0011	17·300	4·000	0·274	0·019	0·003
Ditto . . .	March 1, 1881 . ,	21·280	0·890	None	None	17·800	3·500	0·253	0·025	0·001
Ditto . . .	October 1, 1881. .	22·260	0·760	None	0·0021	16·600	3·900	0·228	0·028	0·003
Ditto . . .	June 1, 1882 .	22·840	0·980	None	None	17·500	3·300	0·256	0·022	0·0053
Ditto . . .	March 1, 1883 . .	22·400	0·980	0·0007	0·0017	17·500	3·200	0·264	0·029	0·006
Twins Well	April 2, 1878 . .	27·820	1·570	None	0·0017	18·790	7·020	0.353	0·022	0·007
Ditto	July 1, 1880. . .	32·760	1·620	0·0070	0·0021	20·700	7·900	0·451	0·029	0·015
Ditto	February 2, 1881 :	35·770	1·870	None	None	21·800	7·900	0·489	0·033	0·008
Ditto	July 1, 1882. . .	33·600	1·700	None	0·0006	21·000	7·900	0·504	0·022	0·0035
Ditto	April 2, 1883 . .	33·800	1·570	Trace	0·0007	21·500	7·400	0·469	0·018	0·004
Ditto	December 1, 1883 .	32·340	1·400	Trace	0·0034	20·000	5·800	0·490	0·045	0·018
Plumstead	February 23, 1878 .	34·990	2·760	None	0·0022	19·530	9·250	0·329	0·025	0·010
Ditto	January 22, 1880 .	36·500	3·190	0·0014	0·0032	21·300	9·800	0·319	0·041	0·008
Ditto	May 3, 1881. . .	34·720	2·760	None	0·0004	21·800	10·500	0·421	0·041	0·009
Ditto . . . . . ,	August 1, 1882 . .	38·220	2·340	0·001	0·0017	21·100	10·150	0·398	0·029	0·008
Ditto	May 2, 1883. . .	37·940	2·380	Trace	0·0011	23.300	11·400	0·563	0·025	0·011
Ditto	January 2, 1884. .	35·140	2·870	0·0007	0·0021	20·800	10·150	0·443	0·048	0·010

DR. BERNAY'S ANALYSES.

Knowing now something of the constitution of these several waters, it is interesting to note the quality of the water as supplied at the Deptford Bridge Police Station. This water varies, of course, according to the well-water most in use at the time of pumping; but, with the information conveyed above, the variations will be quite intelligible.

Place.	Date.	Total solids.	Chlorine.	Free ammonia.	Albuminoid ammonia.	Total hardness.	Permanent hardness.	Oxydized nitrogen.	Organic carbon.	Organic nitrogen.
Deptford Bridge Police Station	April 3, 1877	30·786	1·480	None	0·0007	17·760	5·77	0·355		
Ditto Ditto	May 1, 1877	30·630	1·610	0·0007	0·0010	18·130	5·76	0·332		
Ditto Ditto	June 1, 1877	32·858	1·590	None	0·0007	20·270	6·88	0·414		
Ditto Ditto	July 2, 1877	30·410	1·700	None	0·0018	18·600	6·09	0·339		
Ditto Ditto	August 8, 1877	30·702	1·750	0·0003	0·00056	19·440	6·83	0·329		
Ditto Ditto	October 1, 1877	29·620	1·540	0·0008	0·0022	20·270	5·02	0·420		
Ditto Ditto	November 2, 1877	30·970	1·490	0·0004	0·0031	19·340	6·60	0·350		
Ditto Ditto	December 1, 1877	29·526	1·617	0·00014	0·0007	19·900	6.56	0·298		
Ditto Ditto	January 2, 1878	29·624	1·530	0·00014	0·0024	19·440	6·04	0·378		
Ditto Ditto	February 1, 1878	32·120	1·570	0·00014	0·0008	18·770	7·35	0·343		
Ditto Ditto	March 1, 1878	31·080	1·570	0·0030	0·0017	19·600	5·39	0·327		
Ditto Ditto	April 1, 1878	30·350	1·480	0·0006	0·0024	18·970	6·51	0·322		
Ditto Ditto	May 1, 1878	29·680	1·440	None	0·0043	19·720	4·93	0·401		
Ditto Ditto	June 2, 1878	33·390	1·620	None	0·0025	20·270	7·72	0·411		
Ditto Ditto	July 1, 1878	26·810	1·530	None	0·0015	19·620	5·35	0·326		
Ditto Ditto	August 2, 1878	31·780	1·620	None	0·0007	20·180	6·70	0·358		
Ditto Ditto	September 2, 1878	28·030	1·620	None	0·0004	18·880	4·51	0·360		
Ditto Ditto	October 1, 1878	28·140	1·570	None	0·0007	20·600	4·500	0·346		
Ditto Ditto	November 1, 1878	21·460	0·860	None	None	17·800	4·500	0·246		
Ditto Ditto	December 2, 1878	31·850	1·400	None	0·0004	20·200	6·050	0·410		

Deptford Bridge Police Station	January 1, 1879	28·700	1·530	0·0003	0·0020	20·100	5·150	0·333		
	February 1, 1879	30·600	1·570	0·0003	0·0017	22·000	6·350	0·337		
Ditto Ditto	March 1, 1879	27·580	1·660	0·0004	0·0015	20·500	6·000	0.350		
Ditto Ditto	April 1, 1879	29·850	1·660	None	0·0006	22·300	7·150	0·328		
Ditto Ditto	May 1, 1879	30·030	1·620	None	0·0028	20·100	6·950	0·356		
Ditto Ditto	June 2, 1879	32·510	1·400	0·0008	0·0022	20·300	6·650	0·449		
Ditto Ditto	July 1, 1879	32·720	1·700	None	0·0001	20·900	7·650	0·399		
Ditto Ditto	August 1, 1879	28·660	1·700	None	0·0007	20·300	5·150	0·403		
Ditto Ditto	September 1, 1879	29·010	1·530	None	0·0017	20·100	5·750	0·428		
Ditto Ditto	November 1, 1879	31·930	1·530	None	0·0007	20·000	5·900	0·351		
Ditto Ditto	December 1, 1879	27·860	1·780	0·0013	None	20·700	5·900	0·375		
Ditto Ditto	January 4, 1880	29·400	1·620	None	None	21·000	5·500	0·267		
Ditto Ditto	February 2, 1880	30·410	1·690	0·0014	0·0013	22·400	8·350	0·356		
Ditto Ditto	March 3, 1880	31·290	1·700	0·0006	0·0015	23·300	9·000	0·375		
Ditto Ditto	April 2, 1880	31·190	1·700	None	0·0010	21·800	7·150	0·353		
Ditto Ditto	May 3, 1880	30·800	1·830	0·0008	0·0006	22·000	6·800	0·350		
Ditto Ditto	June 2, 1880	29·890	1·700	0·0001	0·0006	20·000	6·900	0·290		
Ditto Ditto	July 1, 1880	29·960	1·480	None	0·0007	20·300	7·000	0·327		
Ditto Ditto	August 27, 1880	23·480	1·190	None	None	17·020	4·380	0·227		
Ditto Ditto	September 1, 1880	21·730	1·150	None	None	16·100	3·660	0·266		
Ditto Ditto	October 1, 1880	23·520	1·230	None	0·0007	18·300	4·570	0·275		
Ditto Ditto	November 3, 1880	23·130	1·400	0·0010	0·0011	19·200	5·300	0·305		
Ditto Ditto	December 1, 1880	33·040	1·700	0·0049	0·0011	22·900	6·900	0·482		
Ditto Ditto	January 1, 1881	28·980	1·700	0·0042	None	20·900	6·700	0·326	0·031	0·006
Ditto Ditto	February 1, 1881	35·980	1·610	None	None	21·300	7·650	0·490	0·036	0·011
Ditto Ditto	March 1, 1881	31·010	1·600	None	0·0010	21·300	7·100	0·369	0·031	0·007
Ditto Ditto	April 1, 1881	32·830	1·150	0·0007	0·0004	21·300	7·050	0·282	0·025	0·007
Ditto Ditto	May 3, 1881	30·240	1·480	0·0004	0·0014	21·700	6·700	0·319	0·033	0·010
Ditto Ditto	June 1, 1881	32·480	1·270	0·0004	0·0007	21·800	7·400	0·340	0·034	0·010
Ditto Ditto	July 1, 1881	34·650	1·660	0·0003	0·0017	20·900	7·300	0·341	0·036	0·011
Ditto Ditto	August 1, 1881	28·420	1·530	None	0·0018	20·800	7·900	0·298	0·021	0·006
Ditto Ditto	September 1, 1881	29·610	1·660	0·0028	0·0028	19·400	8·000	0·284	0·027	0·010
Ditto Ditto	October 1, 1881	30·310	1·700	0·0006	0·0028	20·800	8·000	0·358	0·036	0·011
Ditto Ditto	November 1, 1881	29·890	1·480	None	0·0014	21·300	7·600	0·333	0·034	0·010
Ditto Ditto	December 1, 1881	31·710	1·480	None	0·0011	21·000	8·000	0·313	0·022	0·0043

DR. BERNAY'S ANALYSES.

Place.	Date.	Total solids.	Chlorine.	Free ammonia.	Albu-minoid ammonia.	Total hardness.	Perma-nent hardness.	Oxydized nitrogen.	Organic carbon.	Organic nitrogen.
Deptford Bridge Police Station	January 1, 1882	26·600	1·020	0·0007	0·0014	19·800	6·150	0·258	0·017	0·0035
	February 1, 1882	31·710	1·570	None	None	21·500	7·150	0·378	0·027	0·010
Ditto Ditto	March 1, 1882	31·470	1·440	None	0·0018	22·300	8·900	0·315	0·029	0·007
Ditto Ditto	April 1, 1882	30·100	1·150	None	0·0021	21·600	6·900	0·332	0·028	0·010
Ditto Ditto	May 1, 1882	29·540	1·660	None	0·0014	21·300	7·000	0·356	0·029	0·008
Ditto Ditto	June 1, 1882	29·540	1·480	None	0·0011	20·800	6·900	0·332	0·031	0·0054
Ditto Ditto	July 1, 1882	31·500	1·570	None	0·0010	20·000	6·650	0·351	0·032	0·007
Ditto Ditto	August 1, 1882	30·240	1·480	0·0010	None	18·300	6·400	0·309	0·031	0·0053
Ditto Ditto	October 1, 1882	30·380	1·360	0·0001	0·0014	20·200	5·150	0·318	0·031	0·011
Ditto Ditto	November 1, 1882	30·800	1·320	0·0006	0·0018	21·300	5·650	0·374	0·027	0·007
Ditto Ditto	December 1, 1882	30·660	1·680	None	0·0007	20·300	6·400	0·335	0.039	0.012
Ditto Ditto	January 1, 1883	30·800	1·680	None	0·0010	20·500	5·650	0·339	0·044	0·012
Ditto Ditto	February 1, 1883	28·560	1·610	None	0·0014	20·100	7·150	0·306	0·033	0·009
Ditto Ditto	March 1, 1883	30·660	1·480	None	0·0021	21·700	7·050	0·333	0·030	0·008
Ditto Ditto	April 2, 1883	30·800	1·480	0·0008	0·0022	21·300	6·900	0·323	0·031	0·006
Ditto Ditto	May 1, 1883	33·600	1·530	None	0·0014	21·800	9·400	0·385	0·035	0·014
Ditto Ditto	June 1, 1883	29·960	1·530	0·0007	0·0020	20·100	6·250	0·361	0·031	0·009
Ditto Ditto	July 2, 1883	32·620	1·610	0·0003	0·0017	21·800	8·050	0·388	0·022	0·006
Ditto Ditto	July 31, 1883	30·520	1·270	0·0010	0·0017	19·800	6·650	0·364	0·030	0·008
Ditto Ditto	September 3, 1883	30·380	1·480	0·0020	0·0022	20·100	7·250	0·323	0·038	0·015
Ditto Ditto	October 1, 1883	29·260	1·440	0·0021	0·0018	20.800	5·650	0·333	0·032	0·010
Ditto Ditto	November 1, 1883	29·540	1·400	None	0·0010	20·300	7·400	0·314	0·030	0·008
Ditto Ditto	December 1, 1883	29·680	1·480	0·0011	0·0014	20·000	5·900	0·340	0·034	0·010
Ditto Ditto	December 31, 1883	29·680	1·190	0·0014	0·0018	20·300	5·900	0·358	0·043	0·009
Ditto Ditto	February 1, 1884	29·820	1·480	0·0008	0·0007	19·000	7·000	0·331	0·020	0·005
Ditto Ditto	March 1, 1884	29·400	1·480	None	0·0004	19·300	7·400	0·342	0·015	0·003
Ditto Ditto	April 1, 1884	28·980	1·400	0·0001	0·0041	18·800	6·650	0·364	0·033	0·010

II.—THE NEW RIVER.

AMONG all the institutions of "still-increasing" London, there is not one which has caused greater interest than that "antient foundation," the New River, which was inaugurated over two centuries and a half ago, namely, on the 29th day of September, 1613, in the reign of King James I.

The ceremonial observed at the inauguration of this great work, which had taken five years to complete, and had cost a vast sum of money, is pleasingly narrated by an old chronicler:—

"On the Michaelmasse-day in anno 1613, being the day when Sir Thomas Myddelton, brother of the said Hugh Myddelton, was elected Lord Maior of London for the yeere ensuing, in the afternoone of the same daye, Sir John Swinnerton, knt., and Lord Maior of London, accompanied with the said Sir Thomas, Sir Henry Montague, knt., Recorder of London, and many of the worthy aldomen, rode to see the Cisterne, and first issuing of the water thereinto, which was performend in this manner:—

"A troope of labourers, to the number of sixty or more, well apparelled, and wearing green Monmouth caps, all alike, carryed spades, shovels, pickaxes, and such like instruments of labourious imployment, marching after drummes twice and thrice about the Cisterne, presented themselves before the mount, where the Lord Maior, Aldermen, and a worthy company beside, stood to behold them; and one man (in behalf of all the rest) delivered this speech:—

"Long have we labour'd, long desir'd, and pray'd
For this great work's perfection ; and by th'ayd
Of Heav'n, and good men's wishes, 'tis at length
Happily conquer'd by cost, art, and strength,
And after five yeeres' deare expence in dayes,
Travaile, and payne, beside the infinite wayes
Of malice, envy, false suggestions,
Able to daunt the spirits of mighty ones
In wealth and courage. This a work so rare
Onely by *one man's* industry, cost, and care,
Is brought to blest effect, so much withstood ;
His onely ayme the Citie's generall good.
And where (before) many injust complaints,
Enviously seated, caused oft restraints,
Stops and great crosses, to our master's charge.
And the work's hindrance, Favour now at large
Spreads herself open to him, and commends
To admiration, both his paines and ends,
(The King's most gracious love). Perfection draws
Favour from Princes, and from all applause.
Then, Worthy Magistrates, to whose content,
(Next to the State) all this great care was bent ;
And for the publicke good (which grace requires),
Your loves and furtherance chiefly, he desires,
To cherish these proceedings, which may give
Courage to some that may hereafter live
To practice deedes of goodnesse and of fame,
And gladly light their actions by his name.

"At which words the flood gates flew open, the streame ranne gallantly into the Cisterne, drummes and trumpets sounding in a triumphall manner, and a brave peale of chambers gave full issue to the intended entertainment."

George Bickman, in the year 1772, published an engraving, entitled "Sir Hugh Myddelton's glory, or the first issuing of the waters into the New River head, before the aldermen, Recorder, and a worthy company who stood to behold it." This engraving (a specimen of which may be seen in the New River Company's annexe) represents the waters flowing into a round reservoir, about which are grouped various persons, conspicuous amongst whom is the Lord Mayor on a white horse. On his left is Sir Hugh Myddelton, on the right is his brother, between Sir Thomas and Sir Henry Montague, the Recorder.

The following is appended to the engraving :—

> "Clerk of the works, reach me the book, to show
> How many arts from which a labour flow.
> First here's the overseer, this try'd man
> An ancient Soldier, and an Artizan.
> The Clerk next him, Mathematician
> The Master of the Timber Work takes place,
> Next after these the Measurer, in like case
> Bricklayer and Engineer, and after these
> The Borer and the Pavier, then it shows.
> The Labourers, next keeper of Amwell Head ;
> The Walkers next so all their names are read.
> Yet these but parcels of six hundred more,
> That at one time have been employed before.
> Yet these in Sight and all the rest will say
> That all the week they had their ready pay.
> Now for the Fruits then : Flow forth precious spring,
> So long and dearly sought for, and now bring
> Comfort to all that love thee ; loudly sing,
> And with thy chrystal murmurs strook together,
> Bid all thy true well wishers welcome hither."

Such was the inauguration of the Company's works, which, after a lapse of 271 years, still continue to supply the City, and North London, with water.

Thanks to the preservation of the records of the time of Charles I., it is possible to give a summary of the History of the New River, from a document which was some years ago discovered among the State papers.

It is not only interesting, but very valuable, being an official description of the undertaking, as given before the judges, and a curious review of one of the earliest troubles the Company had to endure.

While quoting the document in its original phraseology, as far as possible, those numerous repetitions which appear in all legal writings are avoided :—

"Whereas, by virtue of two severall Acts of Parliament, the one made in the third yeare of the raigne of the late King James of ffamous memorie (the first), and the other in the fourteenth yeare of the saide late kings raigne of this realme of England, The Maior, Comonalitie, and Citizens of London, and their successors, had free libertie given unto them, and were enabled to bring a ffresh streame of runing water to the North parts of the said City of London from the springs of Chadwell and Amwell, and other springs in the Countie of Hertford, and not far distant from the said springs.

"And the Said Maior, Comonalitie, and Citizens, considering the greate charge and expense of the saide worke and doubttinge much losse might befall upon the Chamber of the said Cittie, in case the said worke should not succeede well and prove beneficall, did thereupon forbeare at their common charge to undertake the saide worke, soe as the same lay long neglected, and unlike by them to be p'formed. And that Sir Hugh Myddelton, Baronet, deceased, late Citizen and Gouldsmith of London, beinge willing of his owne private charge to undertake the saide worke to that purpose, did make offer to the then Lord Maior, Aldermen, and Comons of the said Citty assembled at a Comon Councell holden within the said Citty on the xxviiith day of March, in the seaventh yeare of the raigne of the saide King James, to undertake the saide worke and to performe (at his owne charges) whatever was or should be necessarie and convenient to be doone and performed on the parte and behalfe of the said Citizens, which saide offer was willinglie accepted and imbraced, by the then Lord Maior, Aldermen and Comon Councell assembled.

"And that thereupon, they, by their indenture under their Comon Seale bearinge date the xxviiith day of March, in the nineth yeare of the raigne of the saide King James, made between the saide Maior, Aldermen, and Citizens, of the one part, and the said Sir Hugh Myddelton, of the other parte, did make and appoint the saide Sir Hugh Myddelton, his heirs and assignes, their true and lawful attorneys, deputies and agents, to carry out the saide worke, confirming to him the whole of the proffit, comoditie, and advantage that should be raysed and gained by the saide River New Cutt and streame, and the water and benefit of the water that might come or be conveyed thereby, and free libertie of laying and conveying the pipes for the currency and passage of water," through the districts authorized.

"And the saide Sir Hugh Myddelton did begin to convey the saide springs in a new channel or river towards the saide Citty of London, and proceeded soe farre therein as that he brought the saide water divers miles towards the saide citty. But finding the charge of the saide worke to be greater, and the difficulties thereabouts to be more than he expected, the saide Sir Hugh Myddelton thought fitt to ioyne unto himselfe for helpe therein some other persons of qualitie which were willinge to adventure and ioyne with him in contribucon towarde the charge of the saide worke, whereupon divers persons of qualitie became Adventurers with the saide Sir Hugh Myddelton in the saide worke, and made severall agreements to pay and contribute, and it was agreed that they should have and receive severallie to them and their heirs ratable shares or parts of the proffits to growe and arise out of the saide worke, according to the proporcon of their severall disbursements, and after they had proceeded soe farre that it was found to be feasible, the saide late King James, considering that the saide worke would be of greate use and benefitt into the saide Citty, and beinge willinge to vouchsafe his ayd by indenture under the greate Seale of England, bearing date the second of May of the tenth yeare of his rayne ower England, did agree to beare and paye the one halfe and moitie of the charges disbursed, and to be expended in perfecting the saide worke, on the condition of payment to him of half the profits, &c.

"And for the better effecting and continuing the saide watercourse, and to make the same usefull for the saide Citty, it was necessary to make and have a greate Store Pond or Poole, whereunto the saide New Cut might emptie itselfe, and thence be derived in pipes unto the saide Citty in some convenient place nere the saide Citty.

"The adventurers at their greater costs and expenses did dig and make one greate and large Store Pond or Poole to receive and keepe the water running in, and cominge from the saide New River, and walled the same roundabout, with a faire brick wall, and at the entry thereof, erected and built a fitt and convenient dwelling house of brick, as a residence for the custodian of the same pondes, and they also made two other waste Pondes adjoining to the saide store Ponde to receive and keep the surplusage of the water of the saide New River when the Store Ponde was full."

A work of considerable difficulty had yet to be accomplished with the New River, namely the distribution of the water to the various parts of the metropolis in which it was needed. "This was done," says an old writer, "with all possible diligence, by pipes of elme and lead, but for the most part elme, from which pipes many high streats and lanes within the city are plentifully served."

In Hughson's 'History of London,' is the copy of a lease for twenty-one years, granted in 1616, by Hugh Myddelton, to a citizen and his wife, "of a pipe or quill of half inch bore, for the service of their yarde and kitchine by means of two Swan necked cocks," in consideration of a certain sum to be paid yearly.

Those who lived at a distance from the mains were supplied by the water carriers, who carried the water in wooden pails slung from a yoke across their shoulders, and attracted notice by crying aloud, "Any New River water here."

By letters patent, dated 21st day of June in the seventeenth year of the said King James, A.D. 1619, Myddelton and the other adventurers therein named were incorporated by the name of the Governor and Company of the New River, brought from Chadwell and Amwell to London, and various rights and privileges were therein conceded to the said adventurers, "after which at a Court holden by the said Governor and Companie at Sergeants Inne in Ffleete Streate, London, on the 2nd day of November, Anno Domini, 1619," the company by agreement granted to Sir Robert Naunton and others on behalf of the king "the one moyetie or half of the clear profits of the said water works," and at subsequents courts, orders were made for the carrying on of the business.

About the year 1631 the affairs of the New River Company became much embarrassed, and King Charles I., who then held the Royal moitie, was therefore led to dispose of his interest in the concern, lest it might prove burdensome to his Exchequer.

Sir Hugh Myddelton "obtained the other moytie in fee farme from his Majestie at and under the rent of 500 li (£500) per annum," executing an indenture accordingly, and the King covenanted that he would not grant or assign his interest, but that it should for ever continue annexed to the Crown, under the name of "King's Clogg." This payment is still annually made to the Royal exchequer.

Hugh Myddelton, while working some Welsh mines, had acquired a good knowledge of levelling, embanking, etc. Hence, after he came to London, the proposal of the City to bring up the water from Chadwell did not appear so visionary a scheme to him as it did to them.

After undertaking the work, he soon found that he had no easy task to construct the aqueduct, some thirty-eight miles in length, not to mention the remarkable opposition he met with on the route from landowners and others. He had expended a very large sum of money, when want of funds compelled him to apply to King James ; accordingly the King advanced to Sir Hugh Myddelton, between the years 1612 and 1616, an amount equal to one-half the then cost of the construction of the work.

The formation of the river occupied five years, although seven years had been allowed to Sir Hugh for its completion. The exertion made is shown by the circumstance that as many as 600 men were employed for some time in the undertaking.

Sir Hugh Myddelton, by his will, dated November 20th, 1631, and proved a month later, leaves all his parts or shares in the New River to his "lovinge wife Dame Elizabeth," and after her death a part or share to each of his three sons and two daughters, and the sixth share to the Goldsmiths Company, of which he was a member, in trust for their poor brethren. He declared in the same deed that one-half of the waterworks was divided into thirty-six shares, of which thirteen belonged to himself; of these thirteen shares, six were disposed of as described above, and the remainder passed into his general estate.

It may here be stated that in 1582 Peter Morrys, a Dutchman (the inventor of a process for raising water by means of a tidal wheel), had come to London and introduced his invention—that "the Lord Maior and a goodly companie" had ridden down to London Bridge to observe his experiments, and had seen him throw the water over St. Magnus' steeple—and that after this the City of London granted him a lease of one of the arches of old London Bridge for 500 years.

The old water-wheel erected by Morrys worked on till about 1822.

The London Bridge Waterworks * were then absorbed by the New River Company, who undertook to supply all citizens whom the Dutchman's wheel had served, with New River water, and to secure the then dividend to the original proprietors of the London Bridge Waterworks for 260 years, the unexpired term of the original lease of 500 years, granted as stated above.

Acts of Parliament were obtained for various special purposes affecting the Company in 1738, 1739, 1767, 1779, 1805, 1822, and 1830. It was under the last named of these Acts that the two large impounding reservoirs at Stoke Newington were made.

In 1852 an Act was passed, wherein the expenditure of the Company in carrying out and completing their works then in existence was stated to be over £1,519,958. The same Act authorised many improvements and works, such as straightening the river, new reservoirs, filter-beds, engine premises, etc.

The New River takes its rise at Chadwell Spring, about

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* For a further description of these Works, see p. 168, *infra*.

one mile beyond Ware, in Hertfordshire. It is joined at a short distance below its source by a branch cut, bringing water from the river Lee. The additional quantity of water thus received is regulated and limited by the action of a floating gauge, placed at the upper end of the cut.

The length of the New River was originally forty miles, but this has been reduced to twenty-eight miles by straightening the channel at various places, where, formerly, it followed the windings of a contour of the ground. At such places the stream is now carried in direct lines by earthen embankments, masonry aqueducts, or tunnel. Along its course are numerous wells with pumping machinery, for raising water from the large subterranean reservoirs of the chalk strata.

The following is a descriptive list of the various stations at which water is raised from wells, stored, filtered, pumped for distribution, or served from covered reservoirs

Broad Mead.—A deep chalk well, with pumping engine of sixteen horse-power.

Amwell End.—A deep chalk well, with pumping engine of fifty-horse power.

Amwell Hill.—A deep chalk well, with pumping engines of seventy-five horse power.

Amwell Marsh.—A deep chalk well, with engine house, in which are now being erected pumping engines of seventy horse-power.

Rye Common.—A deep chalk well, with pumping engines of two hundred horse-power.

Hoddesdon.—A deep chalk well, with pumping engine of fifty horse-power.

Broxbourne.—A deep chalk well, now in process of being sunk.

Turnford.—A deep chalk well, with pumping engines of one hundred and fifty horse-power.

Cheshunt.—A deep chalk well, with pumping engine of twenty horse-power, and two storage reservoirs, having a total area of eighteen and a half acres and a total available capacity of thirty-nine million gallons.

Hoe Lane.—A deep chalk well, with pumping engines of one hundred and seventy horse-power.

Highfield.—A deep chalk well, over which an engine house is now being built for the reception of pumping engines of two hundred and ten horse-power.

Hornsey.—Subsiding reservoirs, having a joint area of eight acres and a total available capacity of eight million five hundred thousand gallons, with eight filter-beds, having a joint area of five and a quarter acres, and pumping engines of four hundred and forty horse-power.

Campsbourne, Hornsey.—A deep chalk well, now in process of being sunk.

Stoke Newington.—Two subsiding reservoirs, having a joint area of forty-two and a half acres and a total available capacity of ninety million gallons, nine filter-beds, having a joint area of nine acres, pumping engines of one thousand and eighty horse-power, and shops for repair of machinery, etc.

New River Head, Clerkenwell.—Subsiding reservoir, having an area of three quarters of an acre ; three filter-beds, having a joint area of two and a quarter acres ; pumping engines of two hundred horse-power, offices, store-houses, testing and stamping shop, meter-repairing, plumbers', blacksmiths' and carpenters' workshops, stabling, etc.

Claremont Square, Pentonville.—A covered service reservoir, having a capacity of three million five hundred thousand gallons.

Hampstead Road.—A deep chalk well, not now used.

Camden Road.—An open service reservoir for unfiltered water, having a capacity of nine hundred thousand gallons. Water is supplied from this reservoir for street watering and trade purposes only.

Hampstead Heath.—A deep chalk well not now used, and five ponds, having a joint area of eleven acres, and a total available capacity of ten million five hundred thousand gallons. These ponds store the surface water of the surrounding district, and are used only for street watering and trade purposes.

Hampstead.—A covered service reservoir, having a capacity of five hundred thousand gallons.

Kentish Town.—A deep well, not now used.

Maiden Lane.—Two covered service reservoirs, having a total capacity of fifteen million gallons.

Highgate.—Eight ponds, having a joint area of nineteen acres, and a total available capacity of nineteen million five hundred thousand gallons. These ponds store the surface water of the surrounding district, and are used only for street watering and trade purposes.

Highgate Hill.—A covered service reservoir, having a capacity of one million gallons.

Hornsey Lane.—A covered service reservoir, having a capacity of three million gallons, with pumping engines of seventy-five horse-power.

Crouch Hill.—Two covered service reservoirs, having a total capacity of twelve million gallons.

Tottenham.—Pumping engines of one hundred and twenty-five horse-power, for raising water from the river Lee. These engines have not been used for more than twenty years.

Betstile, New Southgate.—A deep chalk well, with pumping engines of twenty-four horse-power.

Bourne Hill, Edmonton.—A covered service reservoir, having a capacity of one million five hundred thousand gallons.

Southgate.—A covered service reservoir, having a capacity of one million gallons.

During the summer of last year, as much as thirty million gallons of water per day were pumped to service reservoirs. For the whole of that year, the *average* quantity daily pumped was over twenty-five million gallons; while the *total* supply (including water which was served *without* pumping), amounted on an average to 28,369,711 gallons per day. The Company supply a population of more than a million persons, living in about one hundred and forty thousand houses. For this service, about seven hundred and seventy-two miles of cast iron pipes, (varying in diameter from thirty-six inches to three inches) have been provided.

As an illustration of the manner in which the New River Company have sought to provide for public requirements, attention may be drawn to the fact that more money has been expended in improvements, &c., during the last twenty years than was spent in the constructions of the previous two hundred and fifty years.

Further statistical details relating to this Company's Works will be found in *Statistics of Supply*, *Table No.* 2 (*ante*, facing page 38), and concerning its Capital, Income, Expenditure, and Profits, in *Table No.* 2A appended.

A map is also appended, shewing the parliamentary boundaries of the Company, the position of the principal works, and direction of the mains, the district supplied, and the area under constant supply, which are distinguished by different shadings.

THE NEW RIVER COMPANY.

TABLE No. 2A.—Statement shewing the Capital authorised, raised and expended at the end of each year, together with the Income, Expenditure on Maintenance and Management, Profit on Trading, Interest paid, Net profit, Dividends paid, &c., for each year, during a period of ten years.
Prepared (in connection with the International Health Exhibition of 1884) *for the Diagrams of* COLONEL SIR FRANCIS BOLTON, C.E., *Water Examiner under the "Metropolis Water Act,* 1871," *by* ALFRED LASS, F.C.A.

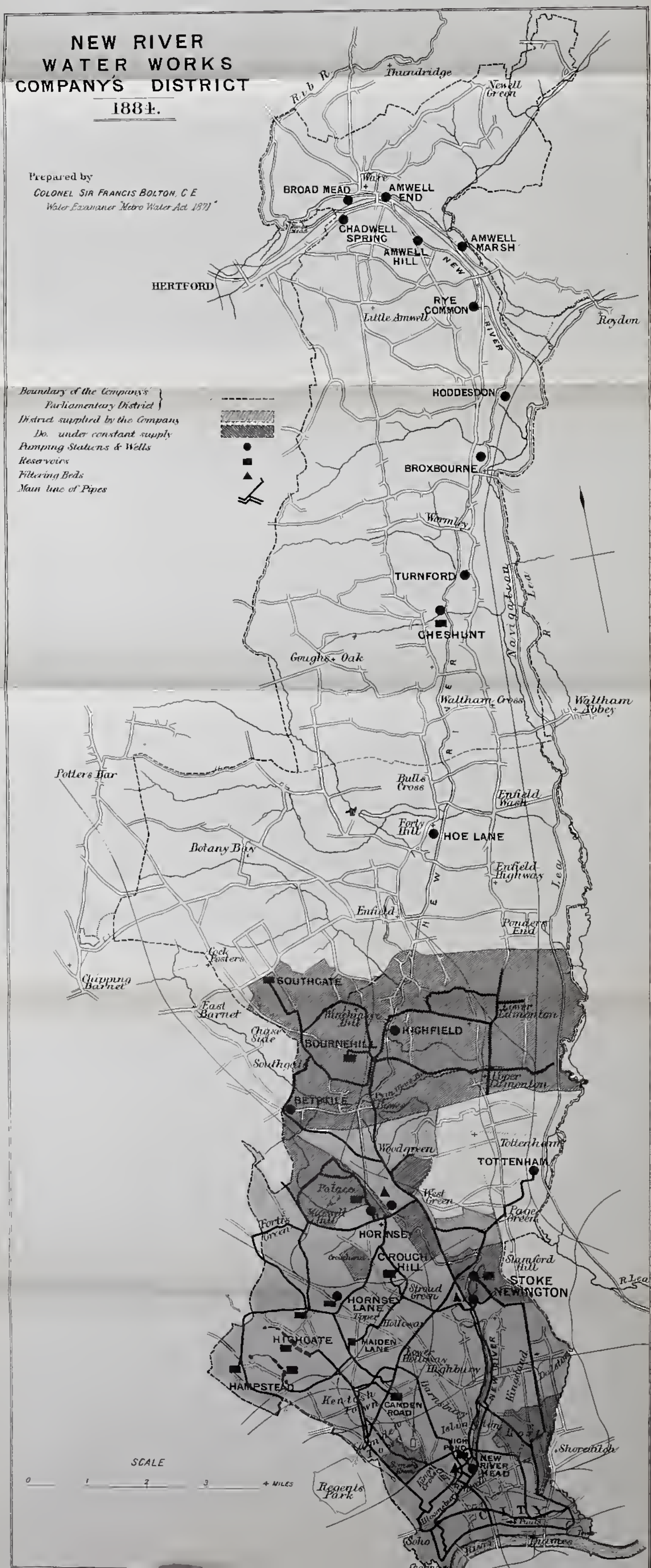
For Year ending	CAPITAL AUTHORISED, RAISED AND EXPENDED (at the end of each Year).											
	Share and Loan Capital authorised.	SHARE AND LOAN CAPITAL RAISED AND PREMIUMS RECEIVED.						Balance of Authorised Capital remaining to be raised.	CAPITAL EXPENDED AND EMPLOYED.			
		Ordinary Stocks and Shares.	Preference Stock.	Bonds and Debentures.	Total Share and Loan Capital raised.	Premiums received.	Total Share and Loan Capital raised and Premiums received.		Capital expended.	Capital in Hand or Overdrawn.		Capital employed.
										In Hand.	Overdrawn.	
31st December,	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.
1873	3,019,958	1,699,558	...	979,957	2,679,515	...	2,679,515	340,443	2,702,304	...	22,789	2,702,304
1874	3,019,958	1,743,158	...	991,193	2,734,351	...	2,734,351	285,607	2,727,949	6,402	.	2,734,351
1875	3,019,958	1,793,728	...	977,293	2,771,021	...	2,771,021	248,937	2,792,202	...	21,181	2,792,202
1876	3,019,958	1,884,898	...	971,643	2,856,541	...	2,856,541	163,417	2,892,802	...	36,261	2,892,802
1877	3,019,958	2,019,958	...	951,593	2,971,551	...	2,971,551	48,407	2,980,214	...	8,663	2,980,214
1878	3,019,958	2,019,958	...	966,443	2,986,401	...	2,986,401	33,557	3,030,138	...	43,737	3,030,138
1879	3,019,958	2,019,958	...	1,000,000	3,019,958	...	3,019,958	...	3,082,878	...	62,920	3,082,878
1880	3,519,958	2,019,958	...	1,099,686	3,119,644	...	3,119,644	400,314	3,132,501	...	12,857	3,132,501
1881	3,519,958	2,019,958	...	1,129,686	3,149,644	3,552	3,153,196	370,314	3,188,175	...	34,979	3,188,175
1882	3,519,958	2,019,958	...	1,208,146	3,228,104	12,488	3,240,592	291,854	3,256,079	...	15,487	3,256,079
Total . . .	...	...	...	..	...	...	...	...	...	...	...	...

For Year ending	INCOME.				
	Gross Water Rents.	Written off as Losses for Empty Houses, Houses Cut off, and Bad Debts.	Net Water Rents.	Miscellaneous Receipts, Rent of Lands, &c.	Total Income.
31st December,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1873	318,481 7 11	20,590 3 6	297,891 4 5	10,000 3 9	307,897 8 2
1874	336,315 16 3	17,570 10 2	318,745 6 1	10,525 10 11	329,270 17 0
1875	349,600 18 10	17,622 2 6	331,978 16 4	10,302 4 8	342,281 1 0
1876	365,154 19 2	17,523 4 4	347,631 14 10	8,350 3 4	355,981 18 2
1877	381,177 15 11	18,509 11 0	362,668 4 11	8,655 5 9	371,323 10 8
1878	397,539 4 5	20,509 9 11	377,029 14 6	10,498 17 0	387,528 11 6
1879	407,673 15 10	22,630 13 3	385,043 2 7	11,786 16 4	396,829 18 11
1880	427,367 8 5	26,551 8 0	400,816 0 5	10,893 8 4	411,709 8 9
1881	447,672 1 6	30,823 12 6	416,848 9 0	8,667 9 10	425,515 18 10
1882	459,321 18 5	31,598 3 8	427,723 14 9	8,895 12 2	436,619 6 11
Total . . .	3,890,305 6 8	223,928 18 10	3,666,376 7 10	98,581 12 1	3,764,957 19 11

For Year ending	EXPENDITURE ON MAINTENANCE.									
	Maintenance of Reservoirs, Filtering Beds, Works and Pipes for Storing Water.	Maintenance of Mains, &c., Meters and Works connected with Distribution, including Renewals.	Pumping and Engine Charges, including Coals.	Filtration.	Salaries of Engineer, Superintendent, Clerks, Inspectors, &c.; Wages of Turncocks; Stationery, Printing, and General Establishment Charges.	Rents of Houses and Lands owing by the Company.	Lea Conservancy and Annuities for purchased Works.	Rates and Taxes, exclusive of Income Tax.	Premises, Insurance Compensations, Superannuation and Law connected with Maintenance.	Total Expenditure on Maintenance.
31st December,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1873	7,633 0 2	22,455 0 9	19,711 10 4	3,869 11 11	5,772 13 5	2,565 8 6	11,643 6 8	17,882 5 5	2,484 4 7	94,017 1 9
1874	6,752 17 1	27,958 6 5	23,717 1 4	3,572 14 9	5,703 2 8	2,658 10 6	11,633 11 2	19,618 12 1	2,482 8 9	104,097 4 9
1875	5,029 17 6	27,327 19 11	21,580 1 9	2,914 13 3	5,427 1 2	2,659 14 3	11,683 6 8	19,279 1 3	3,086 8 5	98,988 4 2
1876	6,778 5 3	22,041 15 10	18,740 11 2	3,007 9 2	7,992 12 6	2,659 19 7	11,683 6 8	24,286 1 11	3,246 10 3	100,436 12 4
1877	6,346 1 5	21,828 0 8	17,915 2 2	3,432 2 11	8,816 1 9	2,661 18 7	11,660 0 0	25,592 7 3	2,927 6 9	101,179 1 6
1878	5,483 13 1	23,261 17 10	21,299 14 3	2,914 1 1	9,229 5 5	2,662 8 4	11,643 6 8	25,311 15 4	4,317 15 11	106,123 17 11
1879	5,130 7 10	26,559 13 11	21,508 7 6	4,055 17 11	9,026 14 7	2,659 2 8	11,616 13 4	27,420 7 2	3,972 3 4	111,949 8 3
1880	4,948 7 1	26,579 3 6	20,132 8 1	3,327 12 10	9,532 4 8	2,660 18 2	12,247 7 10	26,933 3 1	4,381 0 3	110,742 5 6
1881	5,583 19 7	29,517 9 0	18,208 8 8	3,019 4 7	10,481 4 3	2,657 6 6	11,646 13 4	34,057 16 3	4,980 9 4	120,152 11 6
1882	6,274 11 8	27,714 10 2	18,033 13 7	3,530 11 9	10,017 14 6	2,665 7 6	11,626 3 4	36,586 3 8	4,819 17 2	121,268 13 4
Total . . .	59,961 0 8	255,243 18 0	200,846 18 10	33,644 0 2	81,998 14 11	26,510 14 7	117,083 15 8	256,967 13 5	36,698 4 9	1,068,955 1 0

For Year ending	EXPENDITURE ON MANAGEMENT.								
	Directors.	Company's Auditors.	Salaries of Secretary, Accountant and Clerks.	Superannuation, &c.	Collectors.	General Establishment Charges.	Law and Parliamentary, connected with Management.	Official Auditor and Water Examiner.	Total Expenditure on Management
31st December,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1873	5,521 5 3	84 0 0	5,260 19 8	2,789 18 10	10,232 10 0	2,543 12 11	3,856 1 4	388 19 8	30,677 7 8
1874	6,718 9 10	84 0 0	5,654 18 0	2,712 6 6	11,137 0 10	2,684 18 4	440 13 6	275 1 0	29,707 8 0
1875	6,250 13 7	42 0 0	6,206 6 10	2,642 1 8	11,899 12 5	2,494 0 8	1,686 16 11	305 7 2	31,526 19 3
1876	6,463 0 9	126 0 0	5,757 11 10	2,185 0 10	11,507 13 3	2,574 14 4	1,159 7 11	301 14 0	30,075 2 11
1877	6,643 9 4	87 3 0	6,150 15 4	2,215 14 8	11,092 10 9	2,859 16 1	1,449 13 3	304 17 8	30,804 0 1
1878	8,897 1 10	84 0 0	6,662 0 7	2,391 2 3	11,048 15 11	3,221 17 2	4,483 13 2	307 2 1	37,095 13 0
1879	9,355 17 5	84 0 0	7,041 15 7	2,619 4 1	11,676 3 3	3,509 12 7	143 8 0	308 4 10	34,738 5 9
1880	9,419 12 1	84 0 0	7,222 11 8	2,213 9 2	12,131 6 11	3,158 6 6	2,515 7 8	307 1 9	37,051 15 9
1881	9,279 0 10	84 0 0	6,361 5 0	2,870 1 6	12,856 3 10	3,309 4 3	479 0 6	312 1 6	35,610 17 5
1882	9,282 19 2	84 0 0	6,466 2 3	4,721 19 1	13,491 15 8	3,470 18 7	1,177 16 3	348 7 3	39,043 18 3
Total . . .	77,831 10 1	843 3 0	62,784 6 9	27,360 18 7	117,073 12 10	29,887 1 5	17,391 18 6	3,158 16 11	336,331 8 1

For Year ending	Total Expenditure on Maintenance and Management.	Profit on Trading.	Interest paid on Preference and Debenture Stock and Loans, less Interest on Deposits, &c.	Net Profit.	Dividends paid.	Surplus.	Deficiency
31st December,	£. s. d.	£. s. d.	£ s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1873	124,694 9 5	183,202 18 9	37,770 16 1	145,432 2 8	149,068 0 7	...	3,635 17 11
1874	133,804 12 9	195,466 4 3	37,465 19 3	158,000 5 0	157,258 5 11	741 19 1	...
1875	130,515 3 5	211,765 17 7	38,254 0 5	173,511 17 2	172,521 15 11	990 1 3	...
1876	130,511 15 3	225,470 2 11	38,238 5 7	187,231 17 4	180,553 18 7	6,677 18 9	...
1877	131,983 1 7	239,340 9 1	37,143 4 4	202,197 4 9	191,193 3 4	11,004 1 5	...
1878	143,219 10 11	244,309 0 7	37,027 17 1	207,281 3 6	201,895 1 4	5,386 2 2	...
1879	146,687 14 0	250,142 4 11	38,655 18 8	211,486 6 3	201,895 1 4	9,591 4 11	...
1880	147,794 1 3	263,915 7 6	42,405 0 1	221,510 7 5	219,692 9 0	1,817 18 5	...
1881	155,763 8 11	269,752 9 11	43,453 19 0	226,298 10 11	228,686 16 6	...	2,388 5 7
1882	160,312 11 7	276,306 15 4	45,613 13 8	230,693 1 8	233,471 1 6	...	2,777 19 10
Total	1,405,286 9 1	2,359,671 10 10	396,028 14 2	1,963,642 16 8	1,936,235 14 0	36,209 6 0	8,802 3 4


NEW RIVER
WATER WORKS
COMPANY'S DISTRICT
1884.
Prepared by
COLONEL SIR FRANCIS BOLTON, C.E.
Water Examiner "Metro Water Act 1871"
Boundary of the Company's Parliamentary District
District supplied by the Company
Do. under constant supply
Pumping Stations & Wells
Reservoirs
Filtering Beds
Main line of Pipes
BROAD MEAD
AMWELL END
CHADWELL SPRING
AMWELL HILL
AMWELL MARSH
RYE COMMON
HERTFORD
HODDESDON
BROXBOURNE
TURNFORD
CHESHUNT
HOE LANE
SOUTHGATE
HIGHFIELD
BOURNEHILL
BETSTILE
TOTTENHAM
HORNSEY
CROUCH HILL
HORNSEY LANE
STOKE NEWINGTON
HIGHGATE
MAIDEN LANE
HAMPSTEAD
CAMDEN ROAD
NEW RIVER HEAD
Ware
Thundridge
Newell Green
Roydon
Little Amwell
Wormley
Goughs Oak
Waltham Cross
Waltham Abbey
Potters Bar
Bulls Cross
Enfield Wash
Forty Hill
Botany Bay
Enfield Highway
Enfield
Ponders End
Cock Fosters
Chipping Barnet
East Barnet
Chase Side
Southgate
Lower Edmonton
Upper Edmonton
Wood green
Tottenham
West Green
Page Green
Fortis Green
Stamford Hill
Stroud Green
Holloway
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III.—THE EAST LONDON WATERWORKS.

THE Shadwell Waterworks supplied a considerable portion of East London with water, commencing in 1669.

The first Act of Parliament was obtained in 1691; and Thomas Neale, Esq., was appointed "Governor."

In 1747 an Act was passed empowering George Montgomerie and others to complete an undertaking for supplying Stratford, West Ham, Bow, &c., with water; and a pumping station was erected on a branch of the river Lee, the pumps being worked by a water wheel. These works passed out of the possession of the East London Waterworks Company at Christmas, 1883.

In 1807 an Act was passed empowering the London Dock Company to purchase the West Ham Waterworks, and the rights of the proprietors were transferred and vested in the London Dock Company.

In 1807 an Act was passed establishing the East London Waterworks Company, and in the following year an Act was passed empowering the East London Waterworks Company to purchase the Shadwell and West Ham Waterworks from the London Dock Company. The amount of capital authorised by the acts of 1807 and 1808 was £380,000.

The Company constructed at Old Ford settling reservoirs, having an area of about 11 acres. A service reservoir was also made at Mile End. The necessary pumping machinery was erected, and the first engines, named the "Twins," are still at work and in very good condition.

In the year 1809 10,739 houses were in supply, and the gross revenue was £10,051 11*s.* 0*d.* In 1819 the number of houses was 29,926, and the gross revenue £34,370 4*s.* 9*d.*

The basis of charge was according to the number of rooms in each house, the size of the rooms, and the situation of the house. The average rate per house was then £1 2*s.* 11½*d.* per annum. At the present time it is somewhat higher. The average supply of water per house in 1809 was 54 gallons per day. In 1820, this had risen to 135 gallons. The mean elevation at which water was delivered was 120 feet, and a number of houses even then received a constant supply. Mr. Robert Wright, in his evidence before the Select Committee on the Supply of Water to the Metropolis in 1821, stated that he had frequently seen water thrown over the highest houses in Shoreditch by the East London Waterworks Company.

From the establishment of the Company to the time of the Select Committee in 1821, the average dividend was 2¼ per cent. per annum. In 1813, 1814, 1820 and 1821 no dividend was paid.

In 1827 the number of houses supplied was 42,207, and the gross income £45,442 19*s.* 5*d.*

In 1829 the Company purchased the Hackney Waterworks and the Lee Bridge Mills, and also obtained an Act empowering them to remove their intake from Old Ford to Lee Bridge.

Other Acts were passed in 1852 and 1853, fixing the capital and defining the district the Company are authorised to supply. By the latter Act authority was obtained to make several new cuts in connection with the River Lee, for improving the quality of the water, and to construct large impounding reservoirs at Walthamstow, and filter-beds at Lee Bridge, as also to make an intercepting cut or canal on the westerly side of the River Lee from Tottenham to a distance beyond Ponders End, for preventing any polluted water entering the river above the Company's intake.

In 1854 and 1862 Acts were passed for increasing the capital of the Company.

In 1867, an Act was passed to enable the Company to construct a covered service reservoir in Finsbury Park, and also to establish works at Sunbury and Hanworth, for supplying Thames water to their district. All these works were carried out as they now exist.

In the same year a separate Act was obtained for increasing the number of reservoirs at Walthamstow, and filter-beds at Lee Bridge. The Company were also bound to discontinue the use of and to fill up the open reservoirs at Old Ford, and to cease using the open canal connecting the open reservoirs with the works at Lee Bridge.

The company have nine stations, viz.,

Old Ford.
Lee Bridge.
Walthamstow.
Chingford.
Woodford.
Buckhurst Hill.
Hornsey Wood.
Sunbury.
Hanworth.

The Company have three distinct sources of supply—from the River Lee, the intake being at Chingford ; from deep wells in the chalk at Walthamstow and Chingford, and from the River Thames at Sunbury. The latter is a supplementary supply, and is only in use when the water from the Lee and from the wells in the chalk is insufficient for the district.

1. *Old Ford.* At this station the filtered water from Lee Bridge is conveyed by 4-feet cast iron pipes into a covered reservoir containing 1,500,000 gallons, from which 6 engines, with an aggregate of 800 horse-power, pump the water into the district.

It was at this station that the first Cornish pumping engine was erected in London by the late Mr. Wicksteed, a former engineer of the Company. This engine was named "Cornish," and it effected an enormous saving in the cost of pumping as compared with the then existing engines. This engine is still in use, and doing very good duty.

2. *Lee Bridge.* At this station the water from the reservoirs at Walthamstow is received into filter-beds, of which there are 25 with a joint area of 24 acres.

The filtering medium consists of 2 feet of sand, 6 inches of hoggin, and 1 foot of coarse gravel, making a total depth of filtering material of 3 feet, 6 inches.

The district is partly supplied from this station by seven engines of 1050 horse-power. Water power is also used for pumping purposes.

The other buildings consist of stores, workshops, cottages, &c.

2. *Walthamstow.* The water is taken from the River Lee at Chingford, and conveyed by two large brick culverts into the high level reservoirs. The low level reservoirs are supplied from the high level, or from the Company's canal.

The reservoirs are eight in number, and have an area of 220 acres. There are well wooded islands in most of the reservoirs, and the effect is exceedingly picturesque. The total capacity is nearly 900,000,000 gallons, of which 600,000,000 are available to supply the filter-beds at Lee Bridge by gravitation. Here, with so extensive an area for atmospheric influence, oxidation in the most beneficial form takes place, as the water is always passed through these enormous reservoirs before being sent to Lee Bridge for final filtration.

A well with bore-hole is here sunk into the chalk, the depth from surface to bottom of bore being 405 feet; the chalk water is pumped into the district, the motive power being a turbine, capable of giving out seventy horse-power. The fall actuating the turbine is obtained by intercepting the water passing from the high level reservoirs to the canal leading to the Lee Bridge works.

4. *Chingford.* The intake from the River Lee is situated a short distance above Chingford Mill. A well and bore-hole have been sunk into the chalk, and the water so

obtained will be pumped by water power into the district. There is an auxiliary compound steam-engine, for use in case of floods when water power is unavailable.

5. *Woodford.* These works were completed in 1877, and consist of two covered service reservoirs, containing 3,000,000 gallons, and two engines of sixty horse-power each. The level of water in the reservoirs is 171 feet above Ordnance datum ; and water is pumped from these into the higher districts at Woodford, Buckhurst Hill, Loughton, Chigwell, and Walthamstow. The other buildings consist of cottages, store-rooms, &c.

6. *Buckhurst Hill.* A water tower was erected at Buckhurst Hill in 1879. The tank holds 70,000 gallons, and its altitude is 328 feet above Ordnance datum. The immediate neighbourhood and Loughton are supplied from the tower.

7. *Hornsey Wood.* The Hornsey Wood reservoir is situate in Finsbury Park, and is covered. A large number of lawn-tennis courts have been made on the top, and the public have free access over it. It contains 5,000,000 gallons, and is connected with the Thames supply as also with the Lee Bridge Works. Its altitude is 142 feet above Ordnance datum.

8. *Sunbury.* The intake is on the north bank of the Thames above Sunbury Lock. There are two engines, of seventy-five horse-power each, which force the water to the Hanworth Works, about two miles away.

9. *Hanworth.* The water from Sunbury is received into an open reservoir, containing about 5,000,000 gallons, from whence it flows on to six filter-beds, which have a joint area of five acres, and are of similar construction to those at Lee Bridge.

The water, after being filtered, passes into two covered reservoirs, having a joint capacity of 2,500,000 gallons.

There are three engines, having an aggregate of 600 horse-power, which force the water over a tall stand-pipe and through about nineteen miles of 36 inch main, to the Hornsey Wood Reservoir in Finsbury Park, and from thence it gravitates over the whole of the East London Waterworks Company's middle level district.

The chimney at Hanworth is nearly 250 feet in height, and forms a conspicuous object in the landscape.

The East London Waterworks Company laid iron pipes at the commencement of this century, in lieu of the old wooden ones formerly used by the Shadwell and West Ham Companies. The wooden ones were totally inadequate to withstand the pressure. Many large mains then laid are in use now and in good condition. The largest then put down was 36 inches in diameter.

Provision for fires was made by means of wooden plugs, driven into a specially prepared pipe, having a socket looking upwards. The fixing of these has been discontinued for some time past. Hydrants, with sluice valve, are now used instead, and those fixed inside the Metropolitan area have the standard screw thread of the Metropolitan Fire Brigade; those in West Ham, Leyton, Walthamstow, Woodford, Buckhurst Hill, Loughton and the remainder of the Company's district have a thread specially cut to suit the various local fire brigades.

Further statistical details relating to this Company's Works will be found in *Statistics of Supply, Table No.* 3 (*ante*, facing page 38), and concerning its Capital, Income, Expenditure, and Profits in *Table No.* 3A, appended.

A map is also appended, shewing the parliamentary boundaries of the Company, the position of the principal works, and direction of the mains, the district supplied, and the area under constant supply, which are distinguished by different shadings.

THE EAST LONDON WATER WORKS COMPANY.

TABLE No 3A.—Statement shewing the Capital authorised, raised and expended at the end of each year, together with the Income, Expenditure on Maintenance and Management, Profit on Trading, Interest paid, Net Profit, Dividends paid, &c., for each year, during a period of ten years.

Prepared (in connection with the International Health Exhibition of 1884) *for the Diagrams of* COLONEL SIR FRANCIS BOLTON, C.E., *Water Examiner under the "Metropolis Water Act,* 1871," *by* ALFRED LASS, F.C.A.

For Year ending	CAPITAL AUTHORISED, RAISED, AND EXPENDED (at the end of each Year).												INCOME.				
	Share and Loan Capital authorised.	SHARE AND LOAN CAPITAL RAISED AND PREMIUMS RECEIVED.						Balance of Authorised Capital remaining to be raised.	CAPITAL EXPENDED AND EMPLOYED.				Gross Water Rents.	Written off for Empty Houses, Cut off, Bad Debts, &c.	Net Water Rents.	Miscellaneous Receipts, Rents of Lands, &c.	Total Income.
		Ordinary Stocks and Shares.	Preference Stock.	Bonds and Debentures.	Total Share and Loan Capital raised.	Premiums received.	Total Share and Loan Capital raised and Premiums received.		Capital expended.	Capital in Hand or Overdrawn.		Capital employed.					
										In Hand.	Overdrawn.						
31st December,	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1873	2,020,000	1,624,710	850	250,000	1,875,560	37	1,875,597	144,440	1,883,133	...	7,536	1,883,133	171,776 3 10	5,701 19 5	160,074 4 5	3,859 16 6	169,934 0 11
1874	2,020,000	1,624,710	850	250,000	1,875,560	37	1,875,597	144,440	1,895,348	...	19,751	1,895,348	177,474 9 0	4,692 6 4	172,782 2 8	4,142 13 4	176,924 16 0
1875	2,020,000	1,624,710	850	250,000	1,875,560	37	1,875,597	144,440	1,898,086	...	22,489	1,898,086	179,298 9 0	3,916 1 1	175,382 7 11	4,419 9 6	179,801 17 5
1876	2,020,000	1,624,710	850	255,280	1,880,840	37	1,880,877	139,160	1,913,319	...	32,442	1,913,319	186,943 9 2	3,126 16 1	183,816 13 1	3,902 18 9	187,719 11 10
1877	2,020,000	1,624,710	850	330,000	1,955,560	6,730	1,962,290	64,440	1,942,137	20,153	...	1,962,290	194,055 16 2	2,936 8 4	191,119 7 10	3,883 4 0	195,002 11 10
1878	2,020,000	1,624,710	850	330,000	1,955,560	6,730	1,962,290	64,440	1,967,585	...	5,295	1,967,585	204,240 6 1	3,696 19 7	200,543 6 6	3,886 18 9	204,430 5 3
1879	2,020,000	1,624,710	850	394,350	2,019,910	14,036	2,033,946	90	2,027,918	6,028	...	2,033,946	204,004 7 6	3,981 19 11	200,022 7 7	3,919 16 0	203,942 3 7
1880	2,020,000	1,625,560	...	394,440	2,020,000	14,045	2,034,045	..	2,064,546	...	30,501	2,064,546	216,312 0 0	4,336 5 2	211,975 14 10	3,971 8 0	215,947 2 10
1881	2,115,000	1,628,560	...	394,440	2,023,000	17,376	2,040,376	92,000	2,104,030	...	63,654	2,104,030	228,554 2 1	5,372 8 1	223,181 14 0	3,879 5 3	227,060 19 3
1882	2,115,000	1,695,260	...	394,440	2,089,700	82,073	2,171,773	25,300	2,146,126	25,647	...	2,171,773	236,646 15 11	6,194 0 5	230,452 15 6	3,881 2 10	234,333 18 4
Total . . .	...	...	...	...	...	...	...	...	...	...	...	...	1,999,305 18 9	43,955 4 5	1,955,350 14 4	39,746 12 11	1,995,097 7 3

	EXPENDITURE ON MAINTENANCE.										EXPENDITURE ON MANAGEMENT.								
For Year ending.	Maintenance of Reservoirs, Filtering Beds, Works, and Pipes for Storing Water, including re-construction of Filter Beds.	Maintenance of Mains, &c., Meters and Works connected with Distribution, including Renewals.	Pumping and Engine Charges, including Coals.	Filtration.	Salaries of Engineer and Clerks, Wages of Inspector and Turncocks.	Rents of Houses and Lands owing by the Company.	Thames Conservancy and Lea Conservancy.	Rates and Taxes, exclusive of Income Tax.	Compensations, Premises and Mills; Superannuations and Law Expenses connected with Maintenance.	Total Expenditure on Maintenance.	Directors.	Company's Auditors.	Salaries of Secretary, Accountant and Clerks.	Superannuation.	Collectors.	General Establishment Charges.	Law and Parliamentary, including re-adjustment of Boundary Line.	Official Auditor and Water Examiner.	Total Expenditure on Management.
31st December,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1873	4,292 9 7	8,009 4 4	16,085 1 4	2,422 16 8	8,751 12 8	1,654 4 0	3,586 13 4	13,825 2 9	...	58,627 4 8	2,128 8 9	31 18 8	2,383 2 9	543 13 9	5,185 6 4	1,837 15 5	1,059 12 2	193 3 4	13,363 1 2
1874	3,581 13 1	6,734 4 5	15,392 13 5	2,281 12 2	9,618 15 0	1,365 12 0	3,567 5 8	16,074 0 4	...	58,615 16 1	2,119 13 9	42 7 10	2,195 4 5	375 19 1	5,488 18 2	2,017 3 11	401 19 0	191 19 5	12,833 5 7
1875	3,480 5 9	7,513 1 1	13.965 2 11	2,327 11 8	9,123 17 10	1,356 17 0	3,916 13 4	16,202 1 7	...	57,885 11 2	2,117 10 0	42 7 0	2,226 5 6	658 6 0	5,497 18 6	2,265 9 9	952 5 3	211 6 0	13,971 8 0
1876	4,129 12 1	6,907 7 5	13,046 1 6	2,550 16 1	8,667 19 7	1,489 19 6	4,666 13 4	17,412 11 6	...	58,871 1 0	2,124 1 3	42 9 7	2,406 13 6	751 3 3	5,742 11 8	2,372 17 11	1,901 18 0	205 6 4	15,547 1 6
1877	4,438 10 6	6,551 19 6	14,339 0 8	3,270 18 4	9,012 18 4	1,541 17 0	5,177 10 0	19,161 6 10	...	63,494 1 2	2,126 5 0	42 10 6	2,463 13 6	632 6 0	5,932 6 9	3,611 11 10	578 17 1	201 11 7	15,589 2 3
1878	4,888 19 8	7,074 6 4	14,501 17 5	3,661 19 3	9,277 16 2	1,536 17 0	4,836 13 4	20,389 15 2	...	66,168 4 4	2,139 7 6	42 15 9	2,371 6 0	919 11 0	6,126 3 9	2,150 4 1	1,792 2 9	204 7 11	15,745 18 9
1879	8,787 16 11	11,131 10 8	14,847 5 7	3,633 5 5	9,516 18 0	1,536 17 0	5,033 6 8	19,131 19 10	...	73,619 0 1	2,143 15 0	42 17 6	2,402 17 4	851 2 4	6,154 12 11	3,457 14 3	935 15 1	202 7 3	16,191 1 8
1880	7,620 7 3	9,143 6 10	15,568 18 8	3,686 5 3	9,689 15 2	1,537 18 0	5,033 6 8	20,562 9 10	...	72,842 7 8	2,148 2 6	42 19 3	2,654 9 1	881 5 4	6,367 14 4	2,580 7 9	4,703 5 9	203 4 6	19,581 8 6
1881	6,279 8 5	9,801 4 2	18,918 1 9	4,652 17 4	10,437 18 10	1,578 17 9	5,093 6 8	20,617 5 7	...	77,379 0 6	2,145 18 9	42 18 4	2,815 2 9	1,000 14 0	6,675 1 7	3,067 3 8	3,431 7 7	202 1 6	19,380 8 2
1882	6,323 19 1	9,381 19 10	15,550 5 7	3,908 10 7	10,123 12 5	1,579 0 0	5,033 6 8	22,096 8 10	...	73,997 3 0	2,156 17 6	43 2 9	2,619 18 5	1,555 14 10	6,837 6 11	3,404 18 0	1,080 1 9	224 10 11	17,922 11 1
Total . .	53,823 2 4	82,248 4 7	152,214 8 10	32,396 12 9	94,221 4 0	15,177 19 3	45,944 15 8	185,473 2 3	...	661,499 9 8	21,350 0 0	416 7 2	24,538 13 3	8,169 15 7	60,008 0 11	26,765 6 7	16,837 4 5	2,039 18 9	160,125 6 8

For Year ending	Total Expenditure on Maintenance and Management.	Profit on Trading.	Interest on Preference and Debenture Stock and Loans, less Interest on Deposits, &c.	Net Profit.	Dividends paid on Ordinary Stock.	Surplus.	Deficiency.
31st December,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1873	71,990 5 10	97,943 15 1	9,380 5 5	88,563 9 8	93,875 16 9	...	5,312 7 1
1874	71,449 1 8	105,475 14 4	10,425 13 3	95,050 1 1	93,393 18 3	1,656 2 10	...
1875	71,856 19 2	107,944 18 3	10,628 13 7	97,316 4 8	98,213 3 10	...	896 19 2
1876	74,418 2 6	113,301 9 4	11,283 7 3	102,018 2 1	114,920 5 4	...	12,902 3 3
1877	79,083 3 5	115,919 8 5	13,179 4 4	102,740 4 1	98,618 19 7	4,121 4 6	...
1878	81,914 3 1	122,516 2 2	13,959 6 2	108,556 16 0	115,731 18 10	...	7,175 2 10
1879	89,810 1 9	114,132 1 10	16,821 12 6	97,310 9 4	107,741 16 5	...	10,431 7 1
1880	92,423 16 2	123,523 6 8	18,132 10 4	105,390 16 4	107,936 9 1	...	2,545 12 9
1881	96,759 8 8	130,301 10 7	18,224 13 3	112,076 17 4	114,864 19 8	...	2,788 2 4
1882	91,919 14 1	142,414 4 3	17,705 18 1	124,708 6 2	117,208 18 9	7,499 7 5	...
Total	821,624 16 4	1,173,472 10 11	139,741 4 2	1,033,731 6 9	1,062,506 6 6	13,276 14 9	42,051 14 6

IV.—THE SOUTHWARK AND VAUXHALL WATERWORKS.

THE formation of the Southwark and Vauxhall Water Company was effected in 1845, by the amalgamation of two Companies, the Southwark Water Company and the Vauxhall Waterworks Company.

The Borough of Southwark was originally supplied with water by an undertaking called the London Bridge Waterworks, which was established for the supply of water to the Metropolis in the earlier part of the year 1582. In 1767 the Company obtained a lease from the City, and erected two water wheels, in the fifth arch from the North side and the second from the South, under old London Bridge. These wheels remained in operation until the construction of the new Bridge was contemplated, when the removal of the wheels having become inevitable, the Company merged into the New River Company.

About 1771, an Association, not established by Act of Parliament, was formed for providing a portion of the Borough of Southwark with water, the supply for which was obtained from a pond at St. Mary Overies. After several changes of proprietorship the property came into the sole possession of Mr. Edwards Vaughan in 1820, and in 1822 that gentleman made an agreement with the New River Company to purchase from that Company for the sum of £26,550 the whole portion of the London Bridge Waterworks lying South of the Thames, which he then called the Southwark Water Company.

Mr. Edwards Vaughan died in 1833, and in 1834 an Act of Parliament was obtained giving to his representatives the power of selling the Southwark Waterworks.

In the early part of 1839 a Company was formed to purchase the works, and in June of that year the conveyance was finally signed, the Company becoming liable for all expenses from the 1st June, 1839. The purchase money for the property was £41,000, including £16,550 due to the New River Company, as the unpaid portion of the sum agreed to be paid to them by Mr. Edwards Vaughan. At the time of completing the conveyance there was paid accordingly £24,450 to the representatives of Mr. Edwards Vaughan, and to the New River Company £6,550, it being agreed that the remaining portion of £10,000 due to them should be paid off by annual instalments of £2,500.

When the new Company took possession of the works, the supply of water was furnished in bulk by the Lambeth Company, for an annual payment of £2,400. This state of things could clearly only be considered as provisional, both because it left the existence of the Company, or at least their security, dependent on the will of another Company, who might at any time, by giving nine months' notice, withdraw the assistance they afforded, and because the Company's Act of Incorporation of 1834 expressly directed that the supply of water should be taken from the neighbourhood of Battersea and filtered previous to delivery. The Company therefore proceeded at once to acquire the necessary land at Battersea for the construction of the contemplated works, and in 1841 they were in possession of 18 acres of freehold land, on which had been constructed a depositing reservoir of 7 acres, divided into two parts, with entrance and double sluices from the Thames. Also a filter-bed of 2¼ acres; and an engine-house containing, first, an engine of 45 horse-power that had been previously used at Southwark for the supply to that district, and, secondly, a Cornish engine of 160 horse-power, with boiler house, and four Cornish boilers. A standpipe 130 feet high had also been erected, and these works were connected with the district supplied by the Company by an iron main 20 inches in diameter, and 2¼ miles long.

At this time portions of South London were also supplied by an association called the Vauxhall Waterworks Company, originally established on the 6th October, 1804, under the title of the South London Waterworks, an application for powers to construct the works, &c., being made to Parliament in the ensuing session. Under this Act powers were obtained to raise capital to the amount of £80,000, and so favourable was public opinion to the project, that the shares speedily rose to a premium of 50 or 60 per cent. On the 24th June, 1807, the first supply of water was afforded to the public.

Unfortunately for the Company, six weeks later, on the morning of the 6th August, their engine-house and the wooden tank used as a reservoir were destroyed by fire, damage being done to the amount of £2,720.

Temporary arrangements had then to be made for the supply of the fifty-six customers then on the books of the Company, and by the aid of a two horse-power engine this was effected. The directors believing that the fire was caused maliciously, offered a reward of 200 guineas for the detection of the offenders.

At this time only £90 was paid on each share, and although the whole of the income was applied to the improvement and extension of the works, it proved to be inadequate to the requirements of the Company, and therefore in June, 1813, another Act was obtained, empowering the Company to raise a further sum of £80,000.

Owing to the expense of replacing the decayed wooden pipes with iron, and erecting a 40 horse-power engine, engine house and boiler, it became necessary in 1823 to borrow of the Commissioners under the Exchequer Bill Loan Act, a sum of £7,000. In 1825, to meet a further expenditure on account of the pipe plant, 150 new shares were created and added to the capital, these shares being taken by the proprietors at £90 each.

At this time the Company received the river water from a watercourse, or brook, called at Brixton the "Washway," flowing into the Thames at Vauxhall. Repeated disputes arose concerning the jurisdiction over this brook, the banks of which, for want of the necessary repairs, were falling into a most dilapidated state in those places where they were artificially supported.

In 1827-28 auxiliary works at Cumberland Gardens, adjoining the foot of Vauxhall Bridge, were constructed, consisting of a 20 horse-power engine, removed from the works at Kennington Lane, where it had been lying disused since the destruction of the works by the fire in August, 1807; also a 42-inch tunnel leading into the centre of the river, terminating 8 feet below low-water mark. By this means a portion of the water was pumped direct from the river into the reservoir at Kennington Lane; but the bulk of the supply was taken direct from the channel at Vauxhall Creek.

Principally owing to the statements made before a Committee of the House of Commons in 1830, and partly on account of the effect of the removal of old London Bridge and the increasing accumulations in Vauxhall Creek, which the Commissioners of Sewers refused to remove, this supply from Vauxhall Creek at neap tides rapidly decreased in quantity, and became deteriorated in quality. The Company therefore decided to lay down a large iron tunnel to communicate with the inlet laid beneath the bed of the river, and thus convey the river water directly into the Kennington Lane Works. This was completed and taken into use on the 15th September, 1832. This tunnel consisted of a range of iron pipes 48 inches in diameter, laid at a depth of 20 feet for a considerable distance. It probably exceeded in dimensions any previously employed for similar purposes in the Metropolis.

At this period the engine at Cumberland Gardens was used at low water and neap tides to pump the water from the River Thames into the reservoirs at Kennington Lane; but at spring tides the water flowed naturally into the reservoirs, and filled them to a depth of 9 feet.

In Kennington Lane the Company possessed about five acres of land, on which two circular reservoirs were constructed, about 145 feet in diameter, one having a depth of

15 feet 6 inches and the other 12 feet. Both were lined with brick, and the bottom sloped gradually from the circumference to the centre. It was a circumstance in favour of the Company that the source of supply was now situated at the centre of the river, at that time generally pure and bright; but in addition to this, two years later, in 1834, the reservoirs at Kennington Lane were altered and improved, and a new square reservoir and filter-bed were constructed.

In June, 1834, the Company obtained an Act, to remove several difficulties under which they had hitherto laboured, and to extend their limits of supply. This Act also altered the designation of the Company to the Vauxhall Company, in order to avoid mistakes, which were frequently being made by the public in confounding the "Vauxhall" (hitherto called the South London) with the "Lambeth' and the "Southwark" Companies.

In 1840 the south reservoir at Kennington was raised 4 feet, and provision made for erecting an additional engine at Cumberland Gardens. But owing to the general difficulties in which the Company became involved, partly in consequence of the active competition with other Companies, and partly through the large outlay occasioned by the substitution of iron for wooden pipes, with the erection of more powerful pumping machinery, a committee of proprietors was appointed at a general meeting in December, 1841, to investigate the concerns of the Company. This enquiry resulted in a meeting held in March, 1842, at which a new Board of Directors was appointed.

In the Session of 1843 two rival schemes were formulated for the supply of this Company's district. One was however abandoned without proceeding to Parliament, and the other was subsequently successfully opposed before the standing Orders Committee, and the Bill thrown out.

An extension was made at this time in the tunnel pipes in the bed of the river, which were carried out about 70 feet further, so that a supply of water was rendered available at all times of the tide.

At a general meeting in December, 1843, it was first proposed to amalgamate the Vauxhall with the Southwark Company, a committee being appointed to take the matter into consideration, and at a meeting held in November, 1844, it was resolved to take the necessary steps to apply to Parliament for powers to amalgamate the property of the two Companies. These powers were obtained without opposition in the Session of 1845, and the final amalgamation of the two Companies took place on the 1st October of that year, the new Company being called the Southwark and Vauxhall Waterworks Company.

Immediately after the Companies were amalgamated, additional land was bought at Battersea, in order that the whole of the works might be concentrated at one station.

The extension of these works consisted of a large new filter-bed, deposit reservoir, new engine and boiler houses and chimney-shaft, together with the construction of a special engine for lifting the water from the river into the depositing reservoir; also the removal, alteration, and re-erection of the Cornish engine, formerly belonging to the Vauxhall Company, from the works at Cumberland Gardens to the works of the united Company at Battersea.

A new main, twenty-seven inches in diameter, was also laid from these works to Kennington.

In 1846 a new standpipe was erected, 145 feet high, and the old standpipe raised to the same level; a large culvert was also laid into the river for the supply of the lifting engine, for which purpose a number of the cast iron pipes, formerly laid by the Vauxhall Company, for the supply of their Kennington Lane Works, were utilised.

The works at Cumberland Gardens and Kennington Lane, hitherto used for the supply of the Vauxhall Company's district, having now become unnecessary, the engines were finally stopped on the 22nd February, 1847, and the land, together with the engines, buildings, and machinery thereupon (excepting the large Cornish engine), was sold to the Phœnix Gas Company, possession being taken by that company on March 25th, 1847.

In 1850, the culvert through which the supply was obtained from the river was extended further into the bed of the stream, in order to admit of the water required for the supply being taken in only during such portion of the ebb tide as permitted the reflux past the site of the Company's works of the whole of the London drainage.

In 1851 two shallow experimental wells were sunk on land adjoining the reservoirs, for the purpose of ascertaining if an additional supply of water from springs that were believed to exist could be obtained. Although water was found in abundance, it was not sufficiently soft to be suitable for the general purposes of the Company's supply.

At a general meeting held on the 5th November, 1851, it was decided, subject to Parliamentary sanction being obtained, to change the source of supply from Battersea to a point on the Thames a short distance above the village of Hampton. This Act was obtained in the Session of 1852. In order, however, to facilitate the passing of the Act, the Company consented, with the sanction of the Select Committee to whom the Bill was referred, to enter into arrangements for the supply of the Parish of Putney.

Immediately after the Bill had received the Royal assent, contracts were entered into for the intended new works. These consisted at Hampton of the erection of engine and boiler houses, chimney-shaft, and standpipe tower, two reservoirs, dwelling houses, &c.; also six boilers and two direct-acting engines, with cylinder sixty-six inches in diameter, and ten feet stroke, with pump-plunger forty-two inches diameter; also a main thirty-six inches diameter and 23,000 yards long, to convey the water from the new works at Hampton to the existing works at Battersea.

At Battersea the alterations consisted in the removal of the lifting-engine, and the erection in its place of a direct-acting Cornish engine with a seventy-inch cyclinder, ten feet stroke, and pump-plunger thirty-three inches diameter; also two additional boilers thirty feet long. A new filter-bed was constructed, and the engine and boiler houses were extended.

As, in addition to obtaining water above tidal influence, the Act of 1852 contemplated, subject to certain conditions, the Company giving a constant supply to the district, it was deemed desirable to obtain land situated at an elevation capable of commanding the highest portions of the district in order to allow of the construction of service reservoirs thereon. Accordingly, in November, 1854, fourteen acres of land were purchased at Nunhead, Peckham, which came into the Company's possession on the 25th March, 1855.

In the Session of 1855 the Company obtained an Act of Parliament enabling them to raise additional capital to the amount of £288,500.

The new works being sufficiently advanced, on Friday the 26th July, 1855, the first supply of water was pumped from Hampton to Battersea, where preparations had been made to give full effect to the improved quality of the supply. The deposit reservoirs had been cleaned out, and new sand added to the filtering bed.

Owing to the rapid increase in the number of supplies, it was found necessary to further increase the pumping power at Battersea, and in July, 1856, contracts were entered into for the erection of a new boiler-house, chimney-shaft, coal store, &c ; also for an engine with cylinder of 112 inches, and pump plunger of fifty inches diameter, having each a stroke of ten feet ; together with five additional boilers, a new standpipe, and the heightening and connecting of the old standpipe thereto.

That the improvements made up to this date, not only in the works of the Southwark and Vauxhall, but of all the Metropolitan Water Companies, were well and faithfully executed, satisfactory testimony was born in the report to the President of the General Board of Health laid before Parliament in 1856, the Inspector stating, "that the new works have not in fact been limited to what a bare compliance with the provisions of the Act of 1852 would have fulfilled; measures have been adopted for the general improvement of the supplies which evince a proper anxiety on the part of the companies in the discharge of the duties of their position towards the public."

In October, 1856, the first application was made for the supply of water to houses in Wimbledon, and in November, of the same year, the Company decided to erect the necessary engine power and lay the requisite mains, in order to give the supply in accordance with the request.

In June, 1857, by an agreement entered into with the Lambeth Company, it was arranged that the Southwark and Vauxhall Company should supply the upper portion of Wimbledon, and on the 17th September, 1857, the first supply was afforded.

In October, 1858, the 112-inch cylinder engine commenced work, and in the same month instructions were given for the erection of three additional boilers at Battersea.

In 1859 the erection of a river wall in front of the Battersea works was commenced.

In order to guard against any possible interruption in the supply of the Wimbledon and Roehampton districts, the Company commenced in June, 1860, the erection of a duplicate 55-inch engine at the Battersea works.

In August of the same year, consequent on an application from the Parish of Richmond, negotiations were commenced with the then existing Richmond Water Company for the purchase of their works, pipes, &c., and the supply was transferred to the Southwark Company on September 29th, 1861.

In the early part of 1862, the Company commenced the erection of an additional engine at the Hampton works. This engine has a cylinder 70 inches in diameter, and a stroke of 10 feet, with a pump plunger 42 inches in diameter. Three additional boilers were also provided.

In consequence of the new line of the London, Chatham, and Dover Railway passing through a portion of the Company's filters at Battersea, the Company, after suitable arrangements had been made with the Railway Company, constructed, in 1862, two additional filter-beds.

In 1864 six additional boilers were added to the nineteen hitherto at work, and a new dwelling and lodge erected.

In 1866 a new main, 15 inches in diameter, was laid to supply the higher portions of the Peckham district. With the view of providing for the rapid increase in the number of the Company's supplies, the construction of additional works at Hampton was commenced in 1867. These consisted of a river wall, deposit reservoir, three filter beds, and the erection of two engines and eleven boilers, the engines having cylinders 80 inches in diameter, and 10-feet stroke. A new main, 30 inches in diameter, from Hampton to Wandsworth, was also laid in this year.

In 1869 the Company acquired additional land at Battersea, and constructed thereon a depositing reservoir capable of containing 27,000,000 gallons, which, together with the extension works at Hampton, was completed and taken into use in the spring of 1870.

In 1871 the northern depositing reservoir at Battersea was converted into a filter-bed; the floors of the other reservoirs were covered with concrete, and the slopes with brickwork and concrete.

In the same year, in order to provide for the requirements of the Act of 1871, additional works were commenced at Peckham. These consisted of four covered service reservoirs, capable of containing about 18,000,000 gallons, two being situated at a height of 150 feet above Ordnance datum, and two at 200 feet; also the erection of two direct-acting Cornish engines and four boilers, the engines having cylinders 36 inches in diameter, and a stroke of 9 feet. The 30-inch main was also extended from Wandsworth to the new reservoirs, and new 20-inch, 16-inch, and 12-inch distributing mains were laid to connect the works with the various districts to be supplied.

In 1873 further land was acquired at Hampton to provide for future extensions of the works.

In 1874 an additional boiler-house, containing four boilers and a chimney-shaft, was erected at the Hampton old works.

In 1876 the filters at Battersea were renewed throughout, and two of the large beds sub-divided.

In 1878 an additional 30-inch main with flexible joints was laid across the River Thames at Richmond, in order to make this main of uniform diameter throughout its whole length.

In 1881 the Company commenced sinking a deep well to the chalk on land they had acquired at Streatham, and these works are now in progress.

In 1883 three chimney-shafts at the Battersea works, which would have required extensive repairs, were taken down and replaced with a single shaft, capable of giving an ample draught to the whole of the boilers at this station. In the same year four of the oldest boilers were removed and replaced with three Lancashire boilers.

The present source of supply, situation of works, and extent of the district supplied, is as follows :—

The water supplied by this Company is derived from the Thames (from which river it is, by an agreement with the Thames Conservancy, authorised to take 20,000,000 gallons per diem), the intakes being situated on the north side of the river, above Hampton.

There are two sets of works drawing supply from the Thames into subsiding reservoirs.

The upper works send water into the Battersea works, where the same is there filtered, and pumped into the London district.

At the lower works the water is filtered at Hampton, and from the two sets of works the district is supplied by the Company.

This district is contained within an area comprising the following parishes and places :—

All Saints, Wandsworth ; St. Mary, Battersea ; Holy

Trinity, Balham; St. Mary, Lambeth; Brixton; Stockwell; St. Mary, Newington; Kennington; St. Mary Magdalen, Bermondsey; St. Mary, Rotherhithe; St. Giles, Camberwell; Walworth; Christchurch; St. George the Martyr, Southwark; St. Saviour's, Southwark; St. Thomas, Southwark; St. John, Southwark; St. Olave's, Southwark; St. Nicholas, Southwark; St. Paul's, Deptford; Peckham; Peckham Rye; Dulwich; Putney; Mortlake; Barnes; Ham; Petersham; Kew.

The estimated number of inhabitants and houses supplied by this Company at the end of 1883 was as follows:—

Inhabitants . . .	749,345.
Houses	100,154.

Constant supply is now being rapidly extended in the Company's district, and there are at the present time over 10,000 houses so supplied, principally in the Parishes of:—

St. George the Martyr; St. Mary, Newington; St. Giles, Camberwell; and Lambeth.

The average daily supply, as calculated for the year 1883, was 27·23 gallons per head, and 202 gallons per house. The maximum quantity per head was 30·16, and the minimum 23·56 gallons; the total *average* daily supply *for the year* being 20,270,738 gallons, about 18 per cent. of which quantity was used for other than domestic purposes.

The present stations of the Company are situated as follows:—

1. Hampton Works.
2. Battersea Works.
3. Nunhead Works.
4. Streatham Works (in course of construction).
5. Sumner Street (offices).

HAMPTON WORKS.

These works are divided by the Lower Sunbury Road into two portions, that on the north for supplying unfiltered water to the Battersea works, and that on the south and east for filtering and supplying direct into a portion of the district.

The works consist in the first place of masonry and iron inlet from the river, crossing under the road, and supplying two deposit reservoirs, each with an area of upwards of an acre.

The reservoirs are simple excavations, the slopes being lined with coarse gravel, the excavated earth having been utilised for raising the general surface of the ground above the danger of floods. The water flows into tanks provided with suitable screens and sluices, and thence through cast-iron pipes into the engine wells.

The engines and boiler-houses, coal-store, &c., are buildings constructed of brickwork faced with white Suffolk bricks with cement dressings, iron roofs, and slated. The engines are all contained in one house, and are single-acting Bull engines, delivering over a standpipe placed in a tower which also contains one of the chimney shafts.

The two Bull engines (Nos. 1 & 2), which were those originally erected, have cylinders of 66 inches diameter, with 10 feet stroke, and pump hole of 39 inches diameter, pumping 516 gallons per stroke, the average speed being about 6·6 strokes per minute. The other (or No. 3) engine is larger, and was erected in 1864; the diameter of the cylinder is 70 inches, the stroke 10 feet, the diameter of the pump pole 42 inches, and the discharge 600 gallons per stroke, with an average speed of about 7·25 strokes per minute. These engines are supplied with steam by thirteen boilers. The latter are single-flued Cornish boilers, 28 feet long, 5 feet 9 inches diameter, with 3 feet 6 inches flues. Nine of these are situated to the eastward of the engine-house, the chimney-shaft of the flue from these occupying the angle of the stand-pipe tower; the other four are to the south of the engine-house, with a separate shaft.

A store and a workshop are attached to the building, where repairs to machinery, &c., are effected.

The pumps all discharge into a stand-pipe 140 feet high, from whence the water flows through a 36-inch main to Battersea.

Two cottages are attached to these works, for the residence of the managers, &c.

These works are wholly independent, and are connected in no way with those on the eastern side of the road, being solely for supplying water to the Battersea works.

The works on the eastern side are raised well above the height of the highest floods, and consist of a river wall the whole length of the frontage, the intake being part of that already described.

The wall, which is of great strength, is constructed of concrete in blue lias lime, and is faced on the river side, below the bed of the same, with brickwork 14 inches and 9 inches thick. The whole is surmounted with a Bramley fall coping.

The landing-place for coals is at the lower end of the river wall, and has a heavy coping, being also at a lower level to enable the carts to back against the barges for unloading coals, &c.

The inlet tank at the upper end is 36 feet long, and is for the entire length provided with cast iron gratings, with $\frac{1}{4}$ of an inch openings. The water flows from this inlet into the subsiding reservoir, which has a water area of about two and a half acres. Across the western end of this there is a screen which has been formed of a double wall of piles, the space between being filled in with fine hoggin. From this reservoir the water flows through pipes provided with valves into the filter-beds.

These are three in number, each having a sand area of about an acre, and each capable of filtering $2\frac{3}{4}$ million gallons, at the rate of 5 inches per hour, the works having been constructed to supply 7,000,000 gallons of filtered water per diem.

These filter-beds are surrounded and separated by puddle walls, carried down into and incorporated with the clay, so as to prevent the infiltration of either land or river water.

The filter-beds are lined on the bottoms and sides with six inches of concrete, the latter being lined in addition with brick on edge paving to a depth of one foot below the filtering surface.

The filtering medium consists of 12 inches of boulders, six inches of coarse gravel, six inches of fine gravel, twelve inches of hoggin, and 2 feet 6 inches of sand.

The water is let on to the beds through 30-inch cast iron pipes, also arranged to drain the surface when necessary.

Four sand-washers, with drains, &c., are erected for washing the filtering medium from time to time.

The filtered water is collected on the bottom by means of side drains, formed of perforated bricks, into the main culvert, and thence conveyed through a 4-feet circular brick culvert to the engine wells.

The buildings are faced with Suffolk bricks and cement dressings, to correspond as nearly as possible with the old works.

There are two single-acting Cornish beam-engines, with the beams supported on cast iron entablature and columns.

The cylinders are 80 inches in diameter with 10 feet stroke.

The pumps are 24¾ inches diameter, double acting, having same stroke, and deliver through a loaded valve equal to a lift of 210 feet, giving 371 gallons per minute each, and working upon an average 8·5 strokes per minute, delivering into the 30-inch main.

The boilers, which are situated on the east side of the engine house, are eleven in number, each 28 feet in length, 5 feet 10½ inches in diameter, with single tube 3 feet 6 inches.

On the eastern side of the boiler house is the coal store, capable of containing from four to five hundred tons, and on the east of this, again, are two stores.

The chimney shaft is detached from the building. It is 110 feet high, and 5 feet square inside the flue.

A cottage, containing three rooms on one floor, is constructed near the gate for the accommodation of the gate-keeper.

At Hampton, on the Sunbury Road, the Company have some 31 acres of freehold land, on which is now being constructed a system of collecting works, in order to render available the large supply of water found in the gravel beds adjoining the river, so as to enable the Company to draw a supply therefrom at times when the river is in flood.

BATTERSEA WORKS.

These works were originally constructed for taking in the tidal waters of the Thames; and when, in 1854, the intake was removed to Hampton, they were retained as the works of distribution to the district, and have been added to from time to time, till they have attained their present extent.

The total area of ground owned by the Company at this station is about 50 acres, of which 30 acres are occupied by the works, the rest having been obtained for future extensions as opportunities have offered.

The water is received from Hampton into two reservoirs, one of which is bisected by a dividing wall of concrete nearly up to the top water-line, so that they may be practically taken as three. When full they contain 46,000,000 gallons, or about two days' supply. They are lined with concrete, and the slopes with brick on edge paving in addition.

Originally there were six filter-beds, one of which is divided into three parts, and another into two, so that there are practically nine. The total area occupied by these beds is $11\frac{3}{10}$ acres.

They are all enclosed with puddle, and the insides lined with concrete, some with brick on edge up the slopes, others having in addition gravel up portions of the same.

The filtering medium is 5 feet 6 inches in thickness, and consists ot coarse gravel 9 inches, fine gravel 9 inches, hoggin 1 foot, and sand 3 feet.

The water is let on to these beds from the storage reservoirs, and is conducted to the engine wells by means of cast iron pipes, one of 4 feet diameter, and the other of about 27 inches diameter.

For the purpose of draining some of these beds, and emptying the northern reservoirs, a centrifugal pump with boiler has been erected over the main drain tank.

The engine-house contains five single-acting Cornish beam-engines, and one Bull-engine.

They are of the following dimensions, viz. :—

	Beam Engines.					Bull.
	1.	2.	3.	4.	5.	6.
Diameter of cylinder	55"	55"	68"	64"	112"	70"
Length of stroke	8'·0"	8'·0"	10'·0"	9'·6"	10'·0"	10'·0"
Average number of strokes per minute	11·46	11·71	7·24	7·54	6·93	6·27
Diameter of pump pole	15⅝"	15"	33"	33"	50"	33"
No. of gallons per stroke	110	100	360	340	820	360
Lift of water in feet	320 feet		170 feet			
Description of plunger	Double acting		Single acting			

Nos. 1 and 2 of the above engines deliver through loaded valves at a lift of say 320 feet, for the supply of Wimbledon and the other high districts, and Nos. 3 to 6 over a stand-pipe of 170 feet. These are supplied with steam by 24 single-flued Cornish boilers, half being 32 feet long, and the others 28 feet.

Adjoining the boiler-house is a large coal-store, and other stores, one of which contains water-testing offices, &c. There is a gasholder outside.

Between these buildings and the river are the stores, smith's-shop, fitting-shop, and stable.

The fitting-shop is provided with an engine not only for driving the machinery, but also for pumping water for sand-washing purposes.

There are five sand-washers connected with the necessary drains, and deposit tanks for the sand.

The works are faced on the river side with a substantial river wall, constructed of concrete, and faced with brickwork, the whole being surmounted with a substantial stone-coping. The entire length of this frontage exceeds 1400 feet.

A brick wall separates the works from the high road.

A large cottage, containing nine rooms, is constructed for the residence of the manager, and an entrance lodge of 4 rooms for the gatekeeper. In addition there are three detached stores, one for filter-cleaning tools, &c., one for the coal wheelers, and the other for valves and other apparatus used in the district.

There is also a brick experimental tank for testing, &c.

NUNHEAD WORKS.

These are purely distributory works, and consist of four covered reservoirs arranged in pairs, the top water-line of the lower ones being about 146 feet above Ordnance datum, and the upper ones about 186 feet above the same.

The water is raised from the lower to the upper reservoirs by means of two Bull engines, over a standpipe 50 feet high.

The sizes of the engines are as follows :—

Diameter of cylinders, 36 inches ; length of stroke, 9 feet ; diameter of pump hole, 24 inches.

They are together 100 horse-power, the rate of speed being 10 strokes per minute.

They are supplied with steam by four boilers, each 28 feet long, and 5 feet 9 inches diameter, with diameter of tube 3 feet 4 inches.

The coal-store adjoins the boiler-house.

The houses, together with the tower, are of brickwork faced with red and white bricks, and stone dressings.

The lower reservoirs were constructed to contain when full 12,000,000 gallons, the depth of water being computed at 20 feet. They are formed of brickwork and concrete, surrounded by puddle walls, and are arched over on the top.

THE SOUTHWARK AND VAUXHALL WATER WORKS COMPANY.

TABLE No. 4A.—Statement shewing the Capital authorised, raised and expended at the end of each year, together with the Income, Expenditure on Maintenance and Management, Profit on Trading, Interest paid, Net Profit, Dividends paid, &c., for each year, during a period of ten years.

Prepared for the Diagrams of COLONEL SIR FRANCIS BOLTON, C.E., *Water Examiner under the " Metropolis Water Act, 1871," by* ALFRED LASS, F.C.A.

For Year ending	CAPITAL AUTHORISED, RAISED, AND EXPENDED (at the end of each Year).											
	Share and Loan Capital authorised.	SHARE AND LOAN CAPITAL RAISED AND PREMIUMS RECEIVED.						Balance of Authorised Capital remaining to be raised.	CAPITAL EXPENDED AND EMPLOYED.			
		Ordinary Stocks and Shares.	Preference Stock.	Bonds and Debentures.	Total Share and Loan Capital raised.	Premiums received.	Total Share and Loan Capital raised and Premiums received.		Capital expended.	Capital in Hand or Overdrawn.		Capital employed.
										In Hand.	Overdrawn.	
31st March,	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.
1874	2,000,000	832,160	431,260	372,541	1,635,961	423	1,636,384	364,039	1,663,870	.	27,486	1,663,870
1875	2,000,000	844,780	494,290	429,790	1,768,860	423	1,769,283	231,140	1,751,734	17,549	...	1,769,283
1876	2,000,000	863,300	494,700	430,581	1,788,581	423	1,789,004	211,419	1,771,166	17,838	..	1,789,004
1677	2,000,000	863,300	494,700	431,981	1,789,981	423	1,790,404	210,019	1,748,985	41,419	...	1,790,404
1878	2,000,000	863,300	494,700	431,981	1,789,981	423	1,790,404	210,019	1,759,862	30,542	...	1,790,404
1879	2,000,000	863,300	494,700	431,431	1,789,431	720	1,790,151	210,569	1,772,105	18,046	..	1,790,151
1880	2,000,000	868,800	489,200	432,000	1,790,000	727	1,790,727	210,000	1,777,700	13,027	...	1,790,727
1881	2,000,000	868,800	489,200	432,000	1,790,000	727	1,790,727	210,000	1,783,418	7,309	...	1,790,727
1882	2,000,000	897,004	489,200	432,000	1,818,204	727	1,818,931	181,796	1,790,739	28,192	..	1,818,931
1883	2,000,000	900,800	489,200	432,000	1,822,000	4,506	1,826,506	178,000	1,801,613	24,893	...	1,826,506
Total . . .	...	...	...	.	...	...	...	...	...	...	...	...

For Year ending	INCOME.				
	Gross Water Rents.	Written off as Losses, for Empty Houses, Houses Cut off, and Bad Debts.	Net Water Rents.	Miscellaneous Receipts, Rent of Lands, &c.	Total Income.
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	134,651 9 5	5,474 0 5	129,177 9 0	...	129,177 9 0
1875	141,974 19 4	6,942 7 5	135,032 11 11	.	135,032 11 11
1876	146,077 16 4	6,486 10 5	139,591 5 11	43 0 0	139,634 5 11
1877	149,036 12 8	6,083 18 6	142,952 14 2	104 2 3	143,056 16 5
1878	157,439 15 4	6,171 3 0	151,268 12 4	160 7 1	151,428 19 5
1879	176,452 2 4	8,963 12 6	167,488 9 10	274 7 6	167,762 17 4
1880	181,024 19 0	9,897 3 7	171,127 15 5	266 17 2	171,394 12 7
1881	188,260 11 4	10,836 10 5	177,424 0 11	312 11 0	177,736 11 11
1882	192,392 16 11	9,662 3 5	182,730 13 6	203 13 5	182,934 6 11
1883	199,744 0 7	9,978 18 9	189,765 1 10	209 4 10	189,974 6 8
Total . . .	1,667,055 3 3	80,496 8 5	1,586,558 14 10	1,574 3 3	1,588,132 18 1

For Year ending	EXPENDITURE ON MAINTENANCE									
	Maintenance of Reservoirs, Filtering Beds, Works, and Pipes for Storing Water.	Maintenance of Mains, &c., Meters and Works connected with Distribution, including Renewals.	Pumping and Engine Charges, including Coals.	Filtration.	Salaries of Engineer and Clerks, and Wages of Inspector and Turncocks.	Rents owing by the Company.	Thames Conservancy.	Rates and Taxes.	Compensations, Premises and Mills; Superannuations and Law Expenses connected with Maintenance.	Total Expenditure on Maintenance.
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.		£. s. d.
1874	461 10 4	4,821 8 0	27,387 5 8	2,291 5 1	3,121 7 2	237 9 7	1,305 5 0	6,160 15 8	...	45,786 6 6
1875	524 8 7	6,193 7 10	22,933 2 1	2,877 18 3	3,072 18 9	210 5 4	1,305 5 0	6,813 7 7	...	43,930 13 5
1876	581 19 5	5,053 16 3	21,197 10 2	2,842 17 10	3,852 9 8	152 12 11	1,305 5 0	6,701 3 6	...	41,687 14 9
1877	722 13 5	16,297 6 7	21,331 5 9	6,534 19 3	4,225 5 6	84 5 0	1,305 5 0	8,824 0 10	...	59,325 1 4
1878	2,112 10 6	16,643 16 0	20,304 19 6	13,763 15 1	6,135 18 1	42 11 0	1,305 5 0	8,484 0 8	...	68,792 15 10
1879	644 19 5	17,615 3 6	21,607 6 11	3,559 11 4	7,281 11 0	44 14 4	1,805 5 0	9,047 3 0	...	61,605 14 6
1880	486 9 0	21,268 14 2	21,148 16 3	2,230 19 3	6,713 16 1	34 4 4	2,957 17 6	8,154 13 4	...	62,995 9 11
1881	1,910 4 0	22,631 4 2	20,264 5 7	2,601 13 2	7,106 4 10	43 1 0	2,305 5 0	8,713 1 0	...	65,574 18 6
1882	827 18 1	15,489 10 2	19,881 18 10	2,809 8 1	7,717 13 8	189 18 6	2,305 5 0	12,698 11 7	...	61,920 3 11
1883	769 10 4	12,335 16 2	17,355 4 5	2,611 1 9	7,746 6 7	210 1 0	2,305 5 0	13,767 12 10	...	57,100 18 1
Total . .	9,042 3 1	138,350 2 10	213,411 15 2	42,123 9 1	56,973 11 4	1,249 3 0	18,205 2 6	89,364 10 0	...	568,719 17 0

For Year ending	EXPENDITURE ON MANAGEMENT.								
	Directors.	Company's Auditors.	Secretary, Accountant, and Clerks.	Superannuation.	Collectors.	General Establishment Charges.	Law and Parliamentary.	Official Auditor and Water Examiner.	Total Expenditure on Management
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	1,012 10 0	53 3 1	2,240 1 3	189 16 10	4,487 19 3	1,234 5 0	570 5 3	162 16 0	9,950 16 8
1875	1,008 6 8	42 7 0	2,721 4 2	...	4,761 1 0	1,120 0 0	2,216 9 0	180 3 7	12,049 11 5
1876	1,043 6 8	42 7 0	1,283 0 8	226 17 6	4,779 17 2	1,041 15 9	1,511 4 2	197 6 0	10,125 14 11
1877	977 10 0	42 10 6	1,411 7 3	299 1 3	4,488 2 6	1,539 16 5	1,503 11 10	193 18 10	10,455 18 7
1878	1,065 0 0	42 10 6	1,976 2 0	504 1 3	3,433 1 10	1,307 3 1	2,504 1 1	189 13 7	11,021 13 4
1879	1,020 16 8	42 17 6	2,357 9 4	420 0 0	4,187 7 1	993 12 0	1,517 11 7	185 18 11	10,725 13 1
1880	1,531 5 0	42 17 6	2,655 8 3	641 13 4	3,745 5 5	1,020 13 8	2,814 8 10	184 6 7	12,635 18 7
1881	2,050 0 0	43 1 0	2,704 9 2	400 0 0	4,029 19 0	1,080 10 9	3,103 5 3	180 14 7	13,591 19 9
1882	2,041 13 4	64 6 4	2,717 3 0	400 0 0	4,249 16 11	1,720 17 2	1,159 6 6	189 1 5	12,542 4 8
1883	2,054 3 4	64 14 2	2,885 4 4	400 0 0	4,190 4 2	1,542 16 3	1,854 13 5	200 1 7	13,191 17 3
Total . .	13,804 11 8	460 14 7	22,951 9 5	3,481 10 2	42,352 14 4	12,601 10 1	18,754 16 11	1,864 1 1	116,291 8 3

For Year ending	Total Expenditure on Maintenance and Management.	Profit on Trading.	Interest Paid on Preference and Debenture Stocks and Loans, less Interest on Deposits, &c.	Net Profit.	Dividends paid.	Surplus.	Deficiency.
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	55,737 3 2	73,440 5 10	33,912 4 3	39,528 1 7	42,185 12 9	..	2,657 11 2
1875	55,980 4 10	79,052 7 1	34,647 16 3	44,404 10 10	42,932 15 10	1,471 15 0	...
1876	51,813 9 8	87,820 16 3	43,724 11 10	44,096 4 5	43,606 8 0	489 16 5	..
1877	69,780 19 11	73,275 16 6	43,937 13 0	29,338 3 6	37,361 18 5		8,023 14 11
1878	79,814 9 2	71,614 10 3	43,857 13 6	27,756 16 9	27,571 14 8	185 2 1	...
1879	72,331 7 7	95,431 9 9	43,724 3 11	51,707 5 10	31,344 11 8	20,362 14 2	...
1880	75,631 8 6	95,763 4 1	43,132 17 7	52,630 6 6	48,165 17 11	4,464 8 7	...
1881	79,166 18 6	98,569 13 5	43,320 15 7	55,248 17 10	65,779 14 10	...	10,530 17 0
1882	74,462 8 7	108,471 18 4	43,292 10 0	65,179 8 4	61,979 14 5	3,199 13 11	...
1883	70,292 15 4	119,681 11 4	43,097 16 4	76,583 15 0	64,323 15 4	12,259 19 8	..
Total	685,011 5 3	903,121 12 10	416,648 2 3	486,473 10 7	465,252 3 10	42,433 9 10	21,212 3 1

The upper reservoirs were constructed to contain when full 6,000,000 gallons, and are of similar construction, the depth of water being computed at 16 feet.

Repairing shops and stores are situated close to the engine and boiler-houses. Near the entrance are two four-roomed cottages, and a house containing 10 rooms and offices.

The whole of the land occupied by the works contains an area of 14 acres, and is surrounded by an open pale fence 6 feet high.

The Company also own some land on the other slope of the hill.

Telegraphic communication is provided connecting all the stations, and a private telephone line connects the Nunhead works with the Kennington station of the Metropolitan Fire Brigade.

The large mains in the district (excluding the 36-inch main for unfiltered water from Hampton to Battersea Works) are of 30, 27, 24, 21, 18, 16, 15, 12, 10, and 9 inches in diameter, and the services, 5, 4, and 3 inches.

There are about 11,700 fire-plugs. The total area of the district supplied is about 39 square miles, extending from east to west about 13 miles, and from north to south 3 miles.

The total length of the mains and service pipes is about 711 miles, of which about 546 miles are within the Metropolis, and the remainder in the suburbs.

Further statistical details relating to this Company's Works will be found in *Statistics of Supply*, *Table No.* 4 (*ante*, facing page 38), and concerning its Capital, Income, Expenditure and Profits in *Table No.* 4A, appended.

A map is also appended, showing the parliamentary boundaries of the Company (including the extension acquired in 1884), the position of the principal works, and direction of the mains, the district supplied, and the area under constant supply which are distinguished by different shadings.

V.—THE WEST MIDDLESEX WATERWORKS.

THE West Middlesex Waterworks Company received incorporation in 1806, the 46th year of the reign of George III., by an Act of Parliament empowering them to supply with water from the River Thames the parishes of St. Paul, Hammersmith ; St. Mary Abbott's, Kensington ; All Saints, Fulham ; St. Nicholas, Chiswick ; St. Mary, Ealing ; St. Mary, Hanwell; Old Brentford, New Brentford, Heston, Hounslow, All Saints, Isleworth ; such part of the parish of St. Margaret, Westminster, as lies within the town of Kensington, and a part of the parish of St. Luke, Chelsea, in the county of Middlesex ; likewise the parishes of St. Mary, Battersea ; St. Mary, Wandsworth ; St. Mary, Putney ; St. Mary, Barnes ; Mortlake ; St. Mary Magdalen, Richmond ; and St. Anne, Kew, in the county of Surrey.

The share capital was fixed at £30,000, and power was granted to borrow on mortgage the further sum of £50,000.

In 1807, two steam engines of 20 horse-power, with cylinders of 24-inch diameter, and pumps of 18-inch diameter, were erected at Hammersmith, by Messrs. Fenton & Murray, of Leeds, and two reservoirs, to contain 1$\frac{1}{3}$ million gallons each, were constructed, upon land about one furlong from the Thames, and a 2-feet diameter brick tunnel was made, from the Thames to the engine wells ; the water was pumped up from the wells, into the reservoirs, where it was allowed to subside, and was then distributed to the district by the same engines, through 6-inch and 8-inch pipes made of elm.

In the same year (1807) stone pipes were adopted in lieu of wooden pipes, in consequence of the leakage of water through the wood, and a quantity of 2-inch, 5-inch, 8-inch, and 12-inch diameter stone pipes were laid down in various parts of the district; these pipes, however, were found to be porous, and allowed the water to ooze through under pressure, so that in 1808, both wooden and stone pipes were abandoned, and cast-iron pipes adopted.

In 1809, 3½ acres of land were purchased at Campden Hill, Kensington, and a high-service storage reservoir was constructed, 124 feet above Ordnance datum, capable of containing 3,672,000 gallons. This reservoir was completed, and water pumped in from Hammersmith, on the 4th day of December, 1809, with all due solemnity, a 10-inch main having been laid from Hammersmith to the reservoir, with small mains from the reservoir in the direction of London.

In 1810, an Act was obtained to raise a further sum of money, not exceeding £160,000, and to alter, vary, and enlarge the powers of the Act passed in 1806.

New works were constructed at Hammersmith, adjoining the river Thames, and a 70 horse-power engine was erected by Messrs. Boulton & Watt (subsequently increased to 130 horse-power, by adding an additional pump), with large boilers, and the water was drawn from the Thames by means of 36-inch pipes, laid a considerable distance into the channel of the river. A 21-inch main was laid in 1812, to Kensington Reservoir, from the Hammersmith works, and was continued from the reservoir towards Oxford Street and the Tottenham Court Road.

About this date, a well was constructed in the bank of the Kensington Reservoir, with sluices and 28-inch pipes, and a small engine of 6 horse-power was erected, for the purpose of supplying some of the high-services in the district, which could not be commanded from the reservoir, and a standpipe was also erected at the reservoir; but this small engine was abandoned, as the 70 horse-power engine at Hammersmith was found to be capable of raising the water up the standpipe for the high-service supplies.

In 1813, an Act was obtained to raise a further sum of money, not exceeding £160,000, to enable the Company more effectually to carry on their work.

In 1814, another engine of 70 horse-power (subsequently increased to 100 horses, by enlarging the size of the pump), was erected by Messrs. Boulton & Watt, in the same house, alongside the first 70 horse-power engine; and the two 20 horse-power engines, first erected by the Company, were abandoned and sold in 1819; the two reservoirs were subsequently filled up, and the land sold for building purposes. The first water rental acquired by the Company was in 1811, amounting to the small sum of £335 only, and flattering as were the representations at first of the probable advantages of the undertaking to the proprietors, they did not receive any dividend until March 1819, 13 years from the formation of the Company, and the dividends actually paid from the latter period to 1828 were so trivial, that they did not amount to the common interest of money.

In 1822 land was purchased at Barrow Hill (then called little Primrose Hill), adjoining Primrose Hill, and as the Company's district was extending largely, a reservoir was constructed in 1825, to contain $4\frac{3}{4}$ million gallons, at an altitude of 190 feet above Ordnance datum, 15-inch and 21-inch mains being laid to supply this reservoir from the Hammersmith pumping station. A well had been sunk at some period at Barrow Hill, opposite a road now called Wells Road, from which, no doubt, the road took its name. In 1826, after the completion of the reservoir, a temporary steam engine, with pumps, was erected over the well, and the reservoir was partially filled by this means, to ascertain its soundness; but as the well produced such a small supply of water, it was subsequently abandoned, domed over, and the surface made good. Water stood in the well at a level of 184 feet from the surface of the ground.

In the construction of Barrow Hill Reservoir a large district was commanded, in case of fire; and the water being supplied from this reservoir to a certain contour level, by gravitation, during the day, enabled the supplies to the services being given in a shorter time, the reservoir being filled at night by the Hammersmith engines.

In 1826, another engine, of 105 horse-power, with boilers, was ordered of Messrs. Boulton & Watt, for the Hammersmith pumping station, which was completed, with an additional engine and boiler house, in 1828. This engine was required in consequence of the Company's operations having spread over a larger area, and to afford an adequate supply of water to the Barrow Hill Reservoir. The engine was subsequently increased in power to 120 horses, by adding another small pump, which was used to raise the water up a standpipe, erected at Barrow Hill Reservoir, in 1839, to supply the high-services in Hampstead parish that could not be commanded by the reservoir.

Another length of 36-inch conduit pipe was carried out a considerable distance into the Thames at Hammersmith, for supplying the well of this engine.

The district of the Company continued rapidly to increase, and in consequence of objections made with respect to the quality of the Thames water, which the Company desired to improve, land was purchased at Barnes equal to about 110 acres (a portion of which was subsequently sold), for the purpose of making large subsiding reservoirs, so that water should be taken in at a certain time of the tide only. In 1838 two reservoirs were constructed at Barnes, of an area of 8 acres each (the acreage and the capacity of both these reservoirs have subsequently been much altered), and the water was taken in at the upper, or western reservoir, upwards of a mile above the Hammersmith pumping station, being allowed to slowly subside, and flow on to the lower, or eastern reservoir, where it passed through very fine wire screens, into a circular shaft, and was thence allowed to flow by gravitation through a 36-inch cast-iron conduit pipe, which had been laid under the bed of the River Thames, into the engine wells. The old conduits, which were laid for taking the supply direct from the Thames in 1810 and 1826, were subsequently removed from the bed of the river.

The supply of water to the district of the Company continuing to increase, a 30-inch pumping main was laid from the Hammersmith works to the Grand Junction Road, in the Uxbridge Road, in 1851. The number of houses the Company were supplying at this date amounted to about 25,000, and the water pumped to 8¼ million gallons daily. In 1852, in consequence of increased agitation against the Thames water being drawn from the tidal part of the river, an Act was passed, by power of which the point of abstraction of the water from the Thames was removed above the reach of the tide, and Hampton having been selected as the most eligible position for the station, large works were constructed upon land about a quarter of a mile above the village.

Further powers were obtained for increasing the capital of the Company, and the capital was adjusted.

Up to this period £500,478 had been expended upon permanent works, £122,000 of which sum had actually been expended out of income, and no sum of money had been borrowed upon the security of the undertaking. Under this Act the capital of the Company was fixed at £506,300, and the nominal value of the shares was reduced from £100 to £61; powers were also obtained for raising a further sum of money, not exceeding £168,766, and for creating a reserve fund, not exceeding £20,000.

The works at Hampton consisted of two pumping engines of 105 horse-power each, and six boilers, with a 48-inch cast-iron conduit pipe, and screen shaft to the river intake; a 36-inch main was laid from these works, passing under the bed of the river Thames at Richmond, to the subsiding reservoirs at Barnes. These works were successfully completed and in operation in 1855, and the supply from the Thames at Barnes abandoned. It may be more interesting at this point to state, that the two engines have since been enlarged to 120 horse-power each, a new engine of 120 horse-power has been erected, and a second conduit with screen chamber laid from the intake to the engine wells. So rapid has been the progress of the undertaking, that a second 36-inch main has been laid from the Hampton works to the Barnes reservoirs.

Additional land has been purchased, so as to provide for any future extension of works.

In 1853, in consequence of the large quantity of water required to be supplied from the Barrow Hill Reservoir by gravitation, the difficulty of making good the supply by night from the Hammersmith pumping station, the probability of a much larger supply being required for the north-west district, and the fact that the Company had decided to erect a pumping station at Barrow Hill, a 36-inch main was laid, from the Grand Junction Road, near the Bayswater Road (and connected to the 30-inch main from Hammersmith), to the Barrow Hill Reservoir.

In 1854, the Company completed the construction of three filter-beds, of 1⅓ acres area each, at Barnes, with a total thickness of filtering medium of 5 feet 6 inches, consisting of 2 feet 3 inches of Thames sand, 1 foot of Barnes sand, and 2 feet 3 inches of gravel of various degrees of coarseness; the collecting drains being 6 inches in diameter—pierced earthenware drain pipes, laid 20 feet apart.

In 1855, in consequence of the continual increase in the supply of water to the district, a Cornish engine was erected by Messrs. Harvey & Co., at the Hammersmith pumping station, of 250 horse-power, capable of pumping 4½ million gallons of water per day.

The north-west district of the Company continued to extend very rapidly; so much so, that it became impossible to command many of the houses, "from which applications had been made for a supply of water," from the standpipe at Barrow Hill. The Company, therefore, decided to erect a pumping engine at the Barrow Hill Reservoir for the supply of this upper district; and in 1855, a 30 horse-power engine, with suitable boilers, was erected, and a 15-inch main laid. This engine was enlarged to 45 horse-power in 1865.

In 1852, an Act was passed, to make better provision respecting the supply of water to the Metropolis, and amongst other things it was enacted, "that from and after the 31st day of August, 1855, every reservoir within a distance of five miles from Saint Paul's Cathedral, in which water for the supply for domestic use of the Metropolis, or any part thereof, is stored or kept by any company, shall be roofed in or otherwise covered over." Accordingly, in June, 1855, the Barrow Hill Reservoir was covered over with brick arches supported upon brick piers.

In 1859, a second engine of 45 horse-power was erected at Barrow Hill, as the district had become so extended, and it was not considered advisable to depend upon one engine alone.

In 1860, an Act of Parliament was obtained to enable the Company to raise a further sum of money, not exceeding £180,000.

In 1862, the Kensington Reservoir was covered in. This reservoir had been out of use since 1855, as it was not considered advisable to cover it in at that time, the supplies to the district being well commanded by the Hammersmith engines. A considerable district is now supplied by gravitation from this reservoir.

In 1862, also, another filter-bed was constructed at Barnes, of 2¼ acres area, the filtering medium being nearly the same as in the three filter-beds before described, Harwich sand being used, instead of Thames sand. Another subsiding reservoir was constructed, to contain 18¾ million gallons, and one of the old reservoirs (the western) was greatly enlarged in capacity.

In 1864, another Cornish engine, of 300 horse-power, was erected by Messrs. Harvey & Co., at the Hammersmith pumping station, capable of pumping about 5 million gallons per day into the district.

In 1866, an additional filter-bed, of 1¾ acres in area, was constructed out of a portion of one of the old reservoirs (the eastern), the filtering medium and mode of construction being nearly the same as for the before-named filter-beds.

Also, in 1866, an Act of Parliament was obtained, for extending the limits within which the Company may supply water, and for other purposes. The limit comprised the following parishes or places, in addition to the Company's previous district, that is to say, Saint John, Hampstead, Hendon, Willesden, and that part of the parish of Acton which lies to the north of the Great Western Railway, in the county of Middlesex, and all places within the same respectively. By the same Act the quantity of water to be taken from the Thames by the Company was limited to 20 million gallons of water per day.

In 1868, a covered service reservoir was constructed in the Finchley Road, 323 feet above Ordnance level, to contain 2½ millions of gallons. This reservoir was necessary (as the north-west district was rapidly increasing) to command the district in case of fire, and to relieve the Barrow Hill engines in the daytime, so that Hendon and other parts of the district could be supplied by gravitation, the reservoir being filled by the pumping engines in the night-time.

A second 30-inch main was also laid in 1868, from the Hammersmith pumping station to Bayswater, and connected to the 36-inch pumping main in the Grand Junction Road.

In 1869, an Act of Parliament was obtained to enable the Company to raise a further sum of money, by the creation and issue of new shares, not exceeding in the whole £300,000, and the Company, by the same Act, were empowered to borrow on mortgage any sum or sums of money, not exceeding in the whole £200,000; or they may create and issue debenture stock.

In 1871, the Company laid a second 36-inch conduit across the Thames, under the bed of the river, from their works at Barnes, to the Hammersmith pumping station. This second conduit was not absolutely necessary for the supply of water, but to act as duplicate in case of accident to either conduit; but both conduits are open, and water passes through each to the engine wells.

Also, in 1871, an Act was passed to amend the Metropolitan Water Act of 1852, and to make further provision for the supply of water to the Metropolis and certain places in the neighbourhood thereof, and to make better provision for a constant supply. Regulations were made under this Act, and confirmed by the Board of Trade in August, 1872. From this time constant supply was commenced to be given to all new buildings in the Company's district, and notice having been served upon the Metropolitan authority, three districts in poor localities (one in St. Pancras parish, and two in Marylebone parish) have since been placed under constant supply.

In 1874, another Cornish engine, of 135 horse-power, was erected by Messrs. Harvey & Co., at the Hammersmith pumping station, capable of pumping 2¾ million gallons of water per day into the district.

In 1876, another filter-bed, of 2 acres in area, was constructed at Barnes, the filtering medium and mode of construction being similar to the before-named filter-beds.

In 1877, in consequence of the rapidly increasing north-west district, a new 16-inch main was laid, from the pumping station at Barrow Hill to the Kidderpore Reservoir (Finchley Road), thus giving increased facilities for maintaining the supply to this high-level service reservoir and district.

In 1878, the Company were called upon by the Thames Conservancy to lower a portion of the old conduit crossing the River Thames from Barnes to Hammersmith, to allow the bed of the river being dredged, so as to give a deeper waterway for craft to pass up and down at low tide. This was successfully carried out, but at considerable cost.

In 1880, the Company considered it very desirable to enlarge the capacity of one of the subsiding reservoirs at Barnes, as the supply of water to the district had so rapidly increased. The old reservoir (the western) was thus enlarged from an area of 8 acres to an area of 17 acres, and the capacity increased from 22½ million gallons to 57 million gallons.

In 1882, the supply of water to the Company's district had developed to such an extent, that it became necessary to provide more engine power, and to have reserve in case of accident; two new compound rotative beam engines were therefore erected by Messrs. Simpson & Co. with 7 boilers, at the Hammersmith pumping station, capable of pumping 3½ million gallons each engine, per day, into the district. These engines are of the most economical kind, every improvement having been introduced to make them as perfect as possible.

In the same year (1882), a new reservoir was constructed at Barnes, of 7½ acres in area, capable of containing 24 million gallons of water. One of the old reservoirs (the eastern) was enlarged to contain 17¾ million gallons, and several improvements were introduced to aerate the water as much as possible before it flows upon the filter-beds.

Two new filter-beds were also constructed, a little over an area of one acre each. The mode of construction of these filters differs materially from the old filter-beds. The total thickness of the filtering material is 3 feet 6 inches, consisting of 2 feet 6 inches of Harwich sand, and 1 foot of gravel, sifted to two sizes or degrees of coarseness, which material is laid upon a surface of 2-inch, square, earthenware pipes, butt-ended, and laid side by side all over the surface of the bottom of the filter-bed. The section of these filters is shown in full size in the model.

SUMMARY.

The West Middlesex Company have six Stations, viz:—

1. *Hampton.*—Intake from Thames, above that of the Southwark and Vauxhall, and Grand Junction Waterworks. The water flows direct from the river, through fine screens, into the engine wells. There are three engines, of 360

horse-power; the other buildings consist of stores, workshops, cottages, &c.

2. *Barnes.*—The water from Hampton is received at this station into four subsiding reservoirs, containing 117,500,000 gallons; and before passing across the river to the pumping station at Hammersmith, is filtered through eight filter-beds, with a joint area of twelve acres. There is a small engine of 6 horse-power for sand-washing purposes.

3. *Hammersmith* is the chief distributing station, and has eight engines, of 1335 horse-power. The other buildings consist of stores, offices, workshops, cottages, &c.

4. *Kensington* has a covered reservoir, containing 3,672,000 gallons, at an altitude of 124 feet above Ordnance datum. There are also cottages and stores.

5. *Barrow Hill* has a covered reservoir, containing 4,750,000 gallons, at an altitude of 190 feet above Ordnance datum. There are also at this station two engines of 90 horse-power, cottages, offices, and stores.

6. *Kidderpore* consists of one covered reservoir, containing 2,500,000 gallons, at an altitude of 323 feet above Ordnance datum. There are also cottages and stores.

TABLE GIVING THE NUMBER OF HOUSES SUPPLIED; THE GALLONS OF WATER PUMPED DAILY; AND THE NUMBER OF GALLONS SUPPLIED PER HOUSE; ALSO THE NUMBER OF GALLONS SUPPLIED PER HEAD, FROM 1853 TO 1883, EACH TEN YEARS.

Date.	Houses supplied.	Gallons of water pumped daily.	Gallons of water supplied per House.	Gallons of water supplied per Head.
1853 . . .	25,880	5,076,000	196	26·1
1863 . . .	33,137	7,128,000	215	28·6
1873 . . .	45,330	9,396,000	207	27·6
1883 . . .	63,370	12,247,000	193	25·7

TABLE SHOWING THE NUMBER OF HOUSES RECEIVING "CONSTANT SUPPLY" FROM 1873 TO MAY, 1884.

Date.	No. of Houses receiving "Constant Supply."
1873	326
1874	401
1875	624
1876	1,314
1877	2,135
1878	2,902
1879	4,080
1880	7,248
1881	9,121
1882	11,197
1883	14,057
To May, 1884	15,702

The total length of mains and pipes in the Company's district is upwards of 402 miles, varying in diameter from 3 inches to 36 inches. As follows:—

Inches.	Yards.
3	121,650
4	277,723
5	69,653
6	60,118
7	39,698
8	2,356
9	33,263
10	7,871
12	8,301
14	1,763
15	8,668
16	11,464
18	1,604
19	1,252
20	1,230
21	12,035
23	1,041
30	12,661
32	43
36	35,746
Total ..	708,140

Equal to 402 miles 620 yards.

Further statistical details relating to this Company's Works will be found in *Statistics of Supply, Table No.* 5 (*ante*, facing page 38), and concerning its Capital, Income, Expenditure, and Profits, in *Table No.* 5A, appended.

A map is also appended, showing the parliamentary boundaries of the Company, the position of the principal works, and direction of the mains, the district supplied, and the area under constant supply, which are distinguished by different shadings.

THE WEST MIDDLESEX WATER WORKS COMPANY.

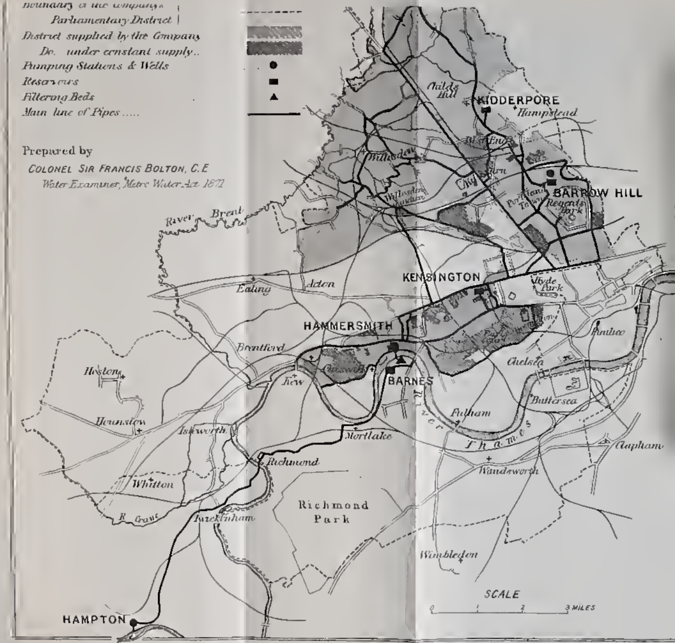
TABLE No. 5A.—Statement shewing the Capital authorised, raised and expended at the end of each year, together with the Income, Expenditure on Maintenance and Management, Profit on Trading, Interest Paid, Net Profit, Dividends Paid, &c., for each year during a period of ten years.

Prepared (*in connection with the International Health Exhibition of* 1884) *for the Diagrams of* COLONEL SIR FRANCIS BOLTON, C.E., *Water Examiner under the "Metropolis Water Act*, 1871," *by* ALFRED LASS, F.C.A.

For Year ending	CAPITAL AUTHORISED, RAISED AND EXPENDED (at the end of each Year).												INCOME.				
	Share and Loan Capital Authorised.	SHARE AND LOAN CAPITAL RAISED AND PREMIUMS RECEIVED.						Balance of authorised Capital remaining to be Raised.	CAPITAL EXPENDED AND EMPLOYED.				Gross Water Rents.	Written off for empty Houses, Cut-off, Bad Debts, &c.	Net Water Rents.	Miscellanous Receipts (Rents of Lands, &c.).	Total Income.
		Ordinary Stocks and Shares.	Preference Stock.	Bonds and Debentures.	Total Share and Loan Capital Raised.	Premiums Received.	Total Share and Loan Capital Raised and Premiums Received.		Capital Expended.	Capital in Hand or Overdrawn.		Capital Employed.					
										In Hand.	Overdrawn.						
31st March,	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	1,355,066	909,974	..	...	909,974	6,998	916,972	445,092	896,926	20,046		916,972	135,629 15 9	4,782 18 11	130,846 16 10	635 2 6	131,481 19 4
1875	1,355,066	919,453		..	919,453	9,365	928,818	435,613	910,826	17,992	...	928,818	139,843 12 7	4,664 4 3	135,179 8 4	679 11 6	135,858 19 10
1876	1,355,066	919,453		...	919,453	9,365	928,818	435,613	933,184	...	4,366	933,184	144,798 9 7	4,689 0 3	140,109 9 4	678 10 6	140,787 19 10
1877	1,355,066	919,453	.	...	919,453	9,365	928,818	435,613	953,908	..	25,090	953,908	151,581 8 10	4,464 1 2	147,117 7 8	586 19 0	147,704 6 8
1878	1,355,066	985,648	.	.	985,648	9,365	995,013	369,418	962,818	32,195	..	995,013	157,139 0 6	4,600 5 3	152,538 15 3	626 14 6	153,165 9 9
1879	1,355,066	998,631	.	...	998,631	17,570	1,016,201	356,435	970,938	45,263	.	1,016,201	159,407 19 3	4,745 7 1	154,662 12 2	530 13 0	155,193 5 2
1880	1,355,066	998,631		.	998,631	17,570	1,016,201	356,435	1,010,380	5,821	..	1,016,201	164,966 2 11	5,919 19 6	159,046 3 5	523 19 4	159,570 2 9
1881	1,355,066	1,045,371	.	...	1,045,371	17,570	1,062,941	309,695	1,030,353	32,588	.	1,062,941	172,487 19 10	6,464 16 0	166,023 3 10	416 10 6	166,439 14 4
1882	1,355,066	1,095,516		...	1,095,516	17,570	1,113,086	259,550	1,100,937	12,149	.	1,113,086	180,292 14 3	7,710 18 0	172,581 16 3	386 13 6	172,968 9 9
1883	1,355,066	1,154,160	.	...	1,154,160	17,570	1,171,730	200,906	1,148,123	23,607	..	1,171,730	187,434 8 11	7,743 11 9	179,690 17 2	407 15 9	180,098 12 11
Total . . .	.	...	..	..	...	. .	...	...	. .	...	...	...	1,593,581 12 5	55,785 2 2	1,537,796 10 3	5,472 10 1	1,543,269 0 4

For Year ending	EXPENDITURE ON MAINTENANCE.										EXPENDITURE ON MANAGEMENT.								
	Maintenance of Reservoirs, Filtering Beds, Works, and Pipes for Storing Water.	Maintenance of Mains, &c., Meters and Works connected with Distribution, including Renewals.	Pumping and Engine Charges, including Coals.	Filtration.	Salaries of Engineer and Clerks, and Wages of Inspector and Turncocks.	Rents owing by the Company.	Thames Conservancy.	Rates and Taxes, exclusive of Income Tax.	Compensations, Premises, and Mills; Superannuation and Law Expenses connected with Maintenance.	Total Expenditure on Maintenance.	Directors.	Company's Auditors.	Salaries of Secretary, Accountant and Clerks	Superannuation	Collectors.	General Establishment Charges	Law and Parliamentary.	Official Auditor and Water Examiner.	Total Expenditure on Management.
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	408 17 6	2,845 7 9	14,539 16 8	954 19 6	5,713 6 6	1,242 4 0	1,317 15 0	5,885 2 1	..	32,907 9 0	1,822 17 9	63 16 0	2,245 2 2	574 19 6	3,541 2 0	1,419 13 2	84 11 6	92 17 7	9,844 19 8
1875	1,223 9 2	2,757 7 8	12,973 6 0	1,087 0 6	5,740 5 2	1,261 14 0	1,317 15 0	5,814 0 7	.	32,174 18 1	1,815 3 10	63 10 8	2,385 14 2	572 15 10	3,641 17 0	1,203 10 9	44 2 0	98 8 9	9,825 3 0
1876	663 13 7	3,388 17 4	12,031 0 5	992 1 9	5,675 11 10	1,315 4 0	1,317 15 0	6,046 19 0	...	31,431 2 11	2,565 2 6	63 10 8	2,497 11 0	572 15 4	3,842 6 10	1,267 1 1	56 19 4	101 19 0	10,967 5 9
1877	1,772 19 5	3,394 19 1	12,529 9 2	983 14 3	5,436 4 11	1,090 4 0	1,318 15 0	7,767 15 11	...	34,294 1 9	2,430 3 9	63 16 0	2,837 11 2	572 13 0	3,964 2 9	1,495 14 3	404 3 6	99 13 6	11,867 17 11
1878	2,265 9 1	4,409 13 1	17,663 2 3	1,169 1 4	5,726 0 10	1,507 13 5	1,318 15 0	8,379 7 10	...	42,439 2 10	2,430 7 6	63 16 0	2,921 0 9	572 13 3	4,148 4 6	1,295 11 1	654 7 3	100 17 4	12,186 17 8
1879	7,516 3 7	4,981 12 0	11,806 2 6	1,222 14 7	6,334 17 10	1,444 14 0	2,318 15 0	8,396 10 1	.	44,021 9 7	2,450 12 6	64 6 8	2,396 18 4	574 8 9	4,223 1 3	1,342 13 10	1,594 12 2	102 12 0	12,749 5 6
1880	1,098 1 2	4,852 6 1	11,545 15 6	2,511 16 9	6,900 7 8	1,730 6 6	2,318 15 0	8,477 10 11	.	39,434 19 7	2,451 1 3	64 6 8	2,545 18 0	574 9 7	4,395 6 2	1,809 6 0	513 12 9	102 17 2	12,456 17 5
1881	1,098 8 8	4,740 12 5	12,434 4 6	1,764 4 7	7,326 5 3	1,058 9 0	2,318 15 0	8,783 2 7	...	39,524 2 0	2,461 5 6	64 12 2	2,645 8 10	353 5 10	4,639 5 0	1,385 5 0	2,632 4 2	101 8 8	14,282 15 2
1882	1,031 1 2	5,577 12 4	13,126 11 1	1,622 8 0	7,411 4 3	1,080 9 0	2,319 15 0	11,904 17 10	.	44,073 18 8	2,451 5 6	95 16 11	2,812 6 6	321 14 2	4,781 8 4	1,315 2 11	220 9 8	110 14 4	12,108 18 4
1883	1,308 8 3	5,344 0 7	14,463 5 0	1,824 15 1	7,463 18 1	1,080 9 0	2,320 15 9	13,252 8 5	..	47,057 19 5	2,466 7 7	128 12 0	3,046 15 1	368 19 5	5,464 5 4	1,456 12 1	308 7 0	122 11 4	13,362 9 10
Total . . .	18,386 11 7	42,292 8 4	133,112 13 1	14,132 16 4	63,728 2 4	12,811 6 11	18,187 10 0	84,707 15 3	.	387,359 3 10	23,344 7 8	736 3 9	26,334 6 0	5,058 14 8	42,640 19 2	13,990 10 2	6,513 9 4	1,033 19 6	119,652 10 3

For Year ending	Total Maintenance and Management.	Profit on Trading.	Interest Paid, less Interest on Deposits, &c.	Net Profit.	Dividends Paid.	Surplus.	Deficiency.		Reserve Fund.	
									Taken from.	Carried to.
March 31st,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.
1874	42,752 8 8	88,729 10 8	deduct 1,475 16 8	87,253 14 0	83,484 0 0	3,769 14 0	.		.	...
1875	42,000 1 1	93,858 18 9	deduct 1,229 17 0	92,629 1 9	83,484 0 0	9,145 1 9	...		..	832 5 11
1876	42,398 8 8	98,389 11 2	add 1,165 6 3	99,554 17 5	90,438 0 0	9,116 17 5	..		..	.
1877	46,161 19 8	101,542 7 0	add 486 0 10	102,028 7 10	90,438 0 0	11,590 7 10	..		..	.
1878	54,626 0 6	98,539 9 3	deduct 1,106 14 8	97,432 14 7	90,438 0 0	6,994 14 7	..		...	
1879	56,770 15 1	98,422 10 1	deduct 256 0 11	98,166 9 2	90,438 0 0	7,728 9 1	...			.
1880	51,891 17 0	107,678 5 9	add 1,125 2 11	108,803 8 8	125,173 5 0	...	16,369 16 4 after payment of back dividends	24,556 10 0		.
1881	53,806 17 2	112,632 17 2	add 958 5 2	113,591 2 4	124,419 12 0		10,828 9 8 " " "	24,556 10 0	..	.
1882	56,182 17 0	116,785 12 9	add 1,169 8 6	117,955 1 3	120,778 0 10	..	2,822 19 7 " " "	17,423 6 0	.	...
1883	60,420 9 3	119,678 3 8	add 1,549 14 9	121,227 18 5	119,571 7 11	1,656 10 6 plus back dividend paid 9,221 4 8	...		..	.
Total	507,011 14 1	1,036,257 6 3	add 2,385 9 2	1,038,642 15 5	1,018,662 5 9	50,001 15 3	30,021 5 7		...	832 5 11



James Wyld 11 & 12 Charing Cross, London.

VI.—THE GRAND JUNCTION WATERWORKS.

The Company possessing the above works derived their original Parliamentary powers for supplying water within certain of the western districts from an Act granted to the Grand Junction Canal Company, in 1798, whereby that Company not only had their powers for the construction and use of a canal, with cuts, aqueducts, and reservoirs, confirmed, enlarged and ratified, but likewise had further powers granted to enable them to construct works and lay down pipes (from such canal, cuts, and reservoirs) for the supply of water to the inhabitants of the parish of Paddington and the parts and places adjacent.

By an agreement entered into at a later date, and subsequently confirmed by Parliament in the 51st year of the reign of George III. (1811), these water supply powers were transferred from the Canal Company to a separate body, who, in consequence of such origin and of the fact of their earliest supply of water being derived from the canal and its feeders, adopted the name of the Grand Junction Waterworks Company.

As a natural result of this agreement, the earliest works of this Company were constructed within the parish of Paddington, somewhat south of the canal basin and north of the road formerly known as the Grand Junction Road, a portion of the original site of which works is now occupied by Talbot and Norfolk Squares.

It being sufficiently proved, however, after some extended experience, that the connection between the Canal Company and the Waterworks Company was not mutually advantageous, and that in consequence of the greatly developed traffic of the canal, it became impracticable for that Company to spare the quantity of water which, by agreement, they had undertaken to afford to the Water Company, a further arrangement was made between the Grand Junction Canal Company, the Regent's Canal Company, and the Grand Junction Waterworks Company, which was sanctioned by Parliament in 1819, whereby the Waterworks Company undertook to transfer their source of supply to the river Thames at Chelsea.

This arrangement, when carried out, was more precisely defined and confirmed by Act of Parliament, in 1826, and from this new source their water was pumped into the reservoirs then existing at Paddington. By the same Act of 1826 enlarged powers, both of district and otherwise, were granted, and the Company were declared to be a Company in perpetuity for supplying water from the river Thames, with a perpetual succession and a common seal.

In 1835, in the reign of William IV., the character of the Thames water in the vicinity of London having somewhat deteriorated, an Act was passed enabling the Company to remove their works and take their supply from a far higher point in the river, namely 350 yards above Kew Bridge.

As this was the first important move in the direction of modern improvement made by the Company, it may be as well to give some slight idea of the work then carried out, and the nature of the improvements effected, under the direction of their very able engineer, Mr. William Anderson, who had been a pupil of the celebrated John Rennie, the first consulting engineer of the Company.

Several acres of land having been purchased near Kew Bridge, on the Middlesex side of the river, a large engine-house, having a handsome, well-proportioned chimney shaft, was erected on that site; and as it was considered of the utmost importance that the Company should be amply provided with the means of increased supply for the then extending district, three steam engines with the requisite number of boilers were erected, having sufficient power to supply satisfactorily the whole of the Company's London district through more than six miles of cast-iron main of 30 inches diameter—the largest main of any considerable length which had at that time been laid down. This line of main connected the new works with the Company's reservoirs at Paddington, and eventually with the whole of the Company's district. The estimate for these extensive works amounted to £95,000, but in the result that sum was very greatly exceeded. The undertaking was carried out by the well-known contractor, Mr. McIntosh.

The progress of building in the parish of Paddington, which was gradually becoming densely populated, induced the Company, at the urgent request of many of the inhabitants and parties interested in the parish, to obtain Parliamentary powers for removing their works, which were beginning to be an eyesore in the midst of these building improvements. Land was therefore purchased, about the year 1844, on the higher ground at Campden Hill, Kensington, when a commencement was made in the construction of the now extensive reservoirs, with engines and boilers, standpipes and tower, there existing; and the Paddington works, no longer needed, were razed to the ground.

For the further advantage of the water tenants, the Company had been long considering the best method which could be adopted for improving the quality of the water in times of disturbance in the river, and, without any suggestion from outside parties, they voluntarily introduced a system of filtration, which during such times enabled them to deliver perpetually a purified and satisfactory supply of water throughout their district.

In the progress of time, however, in consequence of a totally altered system having been adopted with regard to the house drainage of London, which, at first by permission, but afterwards compulsorily, was placed in connection with the sewers and through them with the river Thames itself, a further deterioration of the water took place, which affected the tidal portion of the river for some considerable distance above the Metropolis, reaching at times almost to Kew Bridge itself, the highest point of intake at that time of any of the Thames Water Companies. As this was a state of things not likely to improve, and indeed from year to year was found practically more and more intensified, a general Act of Parliament was eventually passed, in 1852, obliging the Companies to go above the tidal portion of the Thames for their sources of supply.

In consequence of such legislation, this Company had their principal intake removed to a part of the Thames about two miles above Hampton Court, where all necessary works had again to be constructed and adapted to the new and altered state of things.

Without going into any detail of the steps by which these and the other existing works of the Company have arrived at their present extent, and constructive perfection, the simplest plan will be to describe in as few words as possible the present condition of those works, and the whole circumstances of their connection with the general supply of this Company's district, both metropolitan and suburban.

The Company's pumping, filtering, and storage stations are five in number.

1. At the intake at Hampton, between the River Thames and the Upper Sunbury Road.
2. At Kew Bridge, on the Middlesex side of the river.
3. At Campden Hill, Kensington.
4. At Shoot-up Hill, Kilburn ; and
5. At Hanger Hill, Ealing.

The present source of supply, when the river is at its purest, is by means of a double intake of water from the River Thames at Hampton, on the borders of Sunbury, whence the supply is allowed to flow into the open reservoirs, passing thence to the filter-beds. After filtration, the water is conveyed into a covered reservoir, from which point the light of day and the external atmosphere with their many injurious influences are not allowed to affect the purity of its character throughout its whole course, until it reaches the taps and cisterns of the consumers.

In times of disturbance from floods, &c., the river water is received into a third or upper intake which has been constructed somewhat higher up the river, and from which the water flows through gravel screens into a bed of gravel and sand of great thickness underlying nearly the whole of the Company's Hampton station, constituting a natural filter of the most efficient kind, the result of which is at all times to deliver a pure and brilliant water, the lower intakes during the same period being absolutely closed.

Independently of the above process of natural filtration, there are at the Hampton station three filter-beds, with an area of 2¼ acres, through which the water intended for the low-level district, extending from Hampton to Notting Hill, is passed before being pumped into the mains and service pipes; the remaining and more important portion of the supply being pumped on to the Kew Bridge station, there to be again filtered and afterwards distributed throughout the Metropolitan portion of the Company's district.

The other important works at Hampton consist of two subsiding reservoirs, containing six million gallons of water; a large storage reservoir, constructed in 1879, containing forty-five million gallons; and a covered reservoir already alluded to, for the reception of the purified water after filtration, to contain two and a half million gallons; with all necessary pipes, culverts and sluices. There are three Cornish engines, of an aggregate of 784 horse-power, for pumping water, previous to filtration, to the Kew Bridge works, there to be purified and supplied to the Metropolitan district; two rotative engines, of 150 horse-power each, for the supply of the country low-level district above described; and two horizontal engines, with three pumps to each, connected with the underground supply, and capable of raising twelve million gallons per day wholly or in part into the storage reservoir for future use, or into the smaller reservoirs, to be pumped at once to the Kew Bridge works.

Allusion may likewise be made to a small pumping engine for emptying the filters for cleansing operations, and iron boxes for washing the sand. These, with the necessary boiler houses, boilers, coal stores, &c., fairly represent the working arrangements at this station.

In connection with these pumping and filtering works, a line of 30-inch main pipes extends as far as Acton Green, continuing with a pipe of somewhat diminished area through Shepherd's Bush and Notting Hill, terminating in the reservoirs at Campden Hill. This line of pipes forms a supply main to the low-level district comprising Hampton, Hampton Wick, Teddington, Twickenham, Heston, Isleworth, Hounslow, Brentford, Chiswick, Hammersmith, and portions of Acton and Kensington.

A second line of main from the Hampton works, 33 inches in diameter, running almost parallel with the 30-inch main, conveys the water to the Kew Bridge works, where it undergoes subsidence and further filtration, and is eventually forced on for the supply of the London district proper. Various branch mains travel to the several points of the Company's district, and are connected with the service pipes and all the necessary apparatus for the supply of the inhabitants.

The Kew Bridge station, which formerly embraced the principal works of the company, consists of two storage reservoirs, containing 13,500,000 gallons of water; 7 filter-beds, with a joint area of 8½ acres, and 6 pumping engines, with an aggregate of 1031 horse-power, which supply the London district and keep the reservoirs at Campden Hill filled. These engines work into lofty standpipes, which are contained in a handsome tower 180 feet in height. The chimney shaft, in connection with the numerous boilers attached to these engines, has a height of 140 feet. In connection with two of the filter-beds at this station, there is constructed a covered reservoir, of 1½ acres in extent, for the reception of the filtered water which has passed through the filter-beds, and which covered reservoir is in immediate connection with the engine wells, allowing any air that may have been pumped to escape, and the pressure to be equalised and regulated in the large mains.

The Company's station at Campden Hill, Kensington, consists of three reservoirs, capable of containing 18,000,000 gallons of filtered water, at an elevation of 136 feet above Ordnance datum ; and these works being within the radius prescribed by Act of Parliament, they are all covered over to exclude the action of the external light and heat. There are also three engines, with an aggregate of 532 horse-power, for supplying the higher portions of the district and for filling the reservoir at Kilburn.

In addition to the above storage, filtration, and pumping works, the Company have likewise a station at Shoot-up Hill, Kilburn, where there is a covered reservoir at an elevation of 250 feet above Ordnance datum, capable of containing 6,000,000 gallons of water ; and a further reservoir at Hanger Hill, Ealing, containing 3,000,000 gallons of water, at an altitude of 200 feet above Ordnance datum.

The total length of mains in this Company's district is about 352 miles, 262 being constantly charged. They vary from 30 inches in diameter to 3 inches. The principal trunk mains are connected with those of the West Middlesex and East London Companies ; and the conduit mains at Hampton, for the supply of unfiltered water to Kew, have connections with the similar mains of the West Middlesex Company to Barnes, and of the Southwark and Vauxhall Company to Battersea ; while the large mains from Kew and Hampton are so connected to the 36-inch main from the East London Company's pumping station at Sunbury, that the power at those works could be applied at very short notice to the supply of the Grand Junction Company's district, and the works of the latter company could be made to serve any portion of the East London Company's district as far east as Loughton in Essex.

The Company supply more than 48,000 houses, of which 30,000 are supplied on the constant system, great progress having been made in this direction during the past three years. Previously only about 2000 houses were so supplied; but at the present time the only portion of the Company's district supplied on the intermittent system is that lying between Notting Hill and St. James's, Westminster.

The following Acts of Parliament have been passed from time to time to meet the growing requirements of the Company:—

In 1855, powers were granted to raise an additional sum of £200,000 by shares, and £150,000 by bonds, including £23,000 of their former capital, repealing the power given to raise £46,000 formerly granted.

In 1856, an Act was passed introducing some modifications in the Company's charges.

By an Act passed in 1861, the limits of supply were extended to include Chiswick, Acton, Isleworth, Twickenham, Teddington, Hampton, Hampton Wick, Hampton Court, Bushey Park, Whitton and Hanworth.

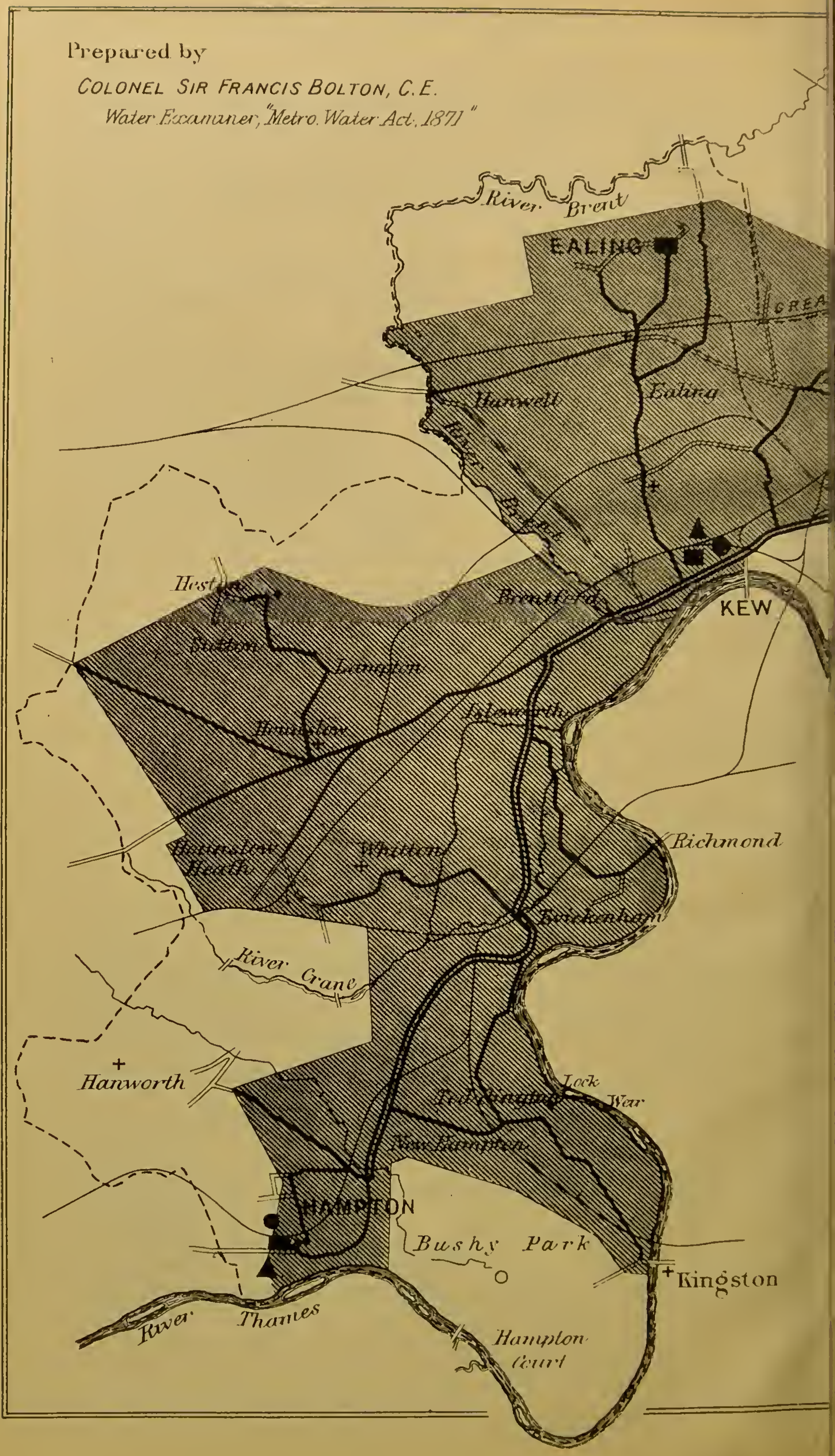
In 1868, an Act was passed by which the capital of the Company was authorised to be increased to

Share capital . . .	£1,000,000
Loan capital . . .	250,000
Total . . .	£1,250,000

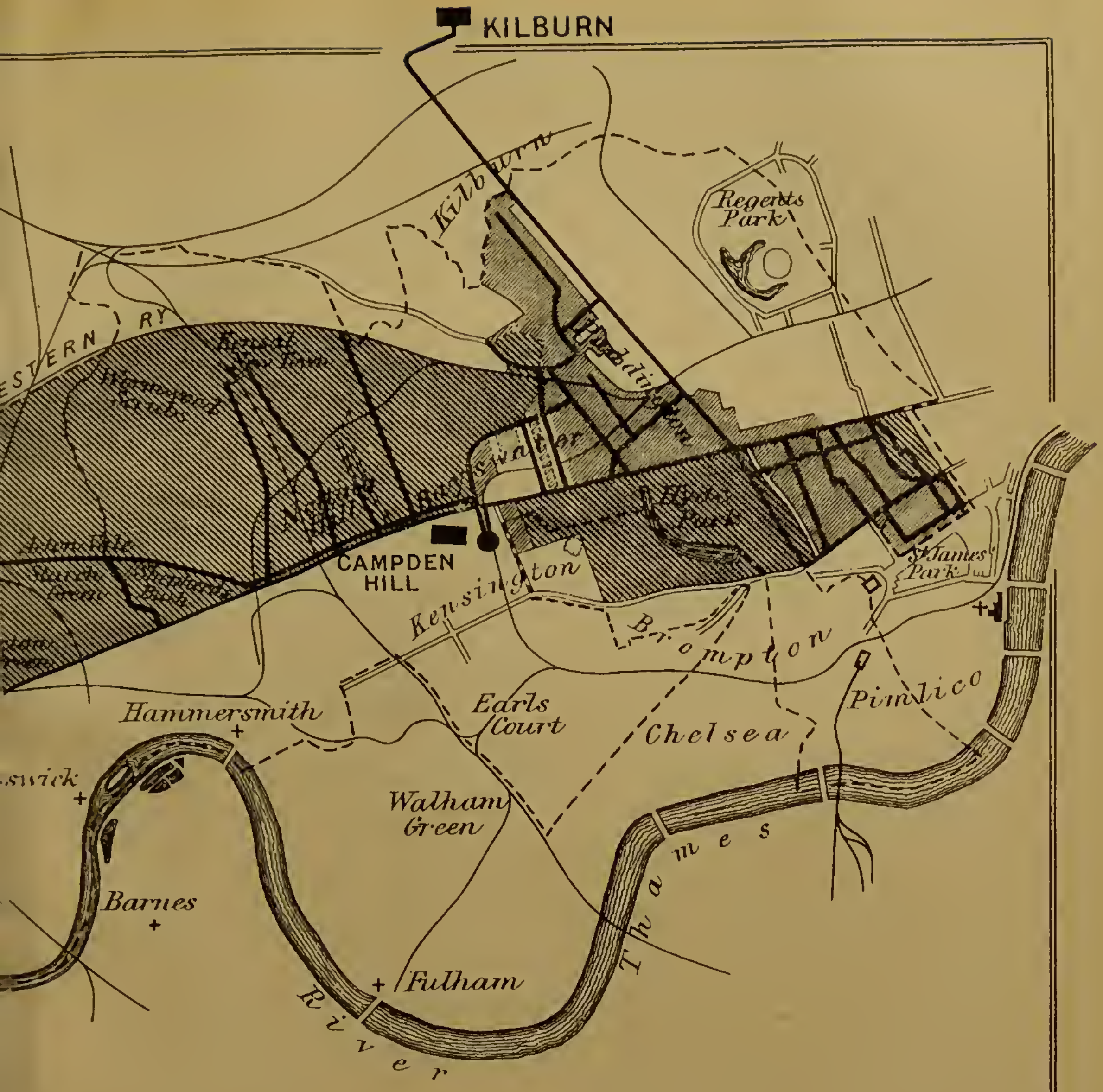
And an Act was passed in 1878, empowering the Company to raise a further amount of capital, equal to £300,000, with borrowing powers to the extent of £75,000.

The Company's works, as they now exist, comprise the following five stations:—

1. Pumping and filtering station at Hampton.
2. " " " Kew Bridge.
3. Storage reservoirs and pumping station at Campden Hill, Kensington.
4. Storage reservoir at Kilburn.
5. " " Ealing.



Prepared by
COLONEL SIR FRANCIS BOLTON, C.E.
Water Examiner, "Metro. Water Act, 1871"



GRAND JUNCTION
TER WORKS COMPANY'S DISTRICT.
1884.

Boundary of the Company's Parliamentary District	...... - - - - -
District supplied by the Company	▨
Do. under constant supply	▩
Pumping Stations & Wells	●
Reservoirs	■
Filtering Beds	▲
Main line of Pipes	═

SCALE

0 1 2 3 4 MILES

James Wyld, 11 & 12, Charing Cross, London.

THE LAMBETH WATER WORKS COMPANY.

TABLE No. 7A.—Statement shewing the Capital authorised, raised and expended at the end of each year, together with the Income, Expenditure on Maintenance and Management, Profit on Trading, Interest paid, Net Profit, Dividends paid, &c., for each year, during a period of ten years.

Prepared (in connection with the International Health Exhibition of 1884) for the Diagrams of COLONEL SIR FRANCIS BOLTON, C.E., *Water Examiner under the "Metropolis Water Act, 1871," by* ALFRED LASS, F.C.A.

For Year ending	CAPITAL AUTHORISED, RAISED AND EXPENDED (at the end of each Year)												INCOME.				
		SHARE AND LOAN CAPITAL RAISED AND PREMIUMS RECEIVED.							CAPITAL EXPENDED AND EMPLOYED.								
										Capital in Hand or Overdrawn.							
	Share and Loan Capital authorised.	Ordinary Stocks and Shares.	Preference Stock	Bonds and Debentures.	Total Share and Loan Capital raised.	Premiums received.	Total Share and Loan Capital raised and Premiums received.	Balance of Authorised Capital remaining to be raised.	Capital expended.	In Hand.	Overdrawn.	Capital employed.	Gross Water Rents.	Written off as Losses, for Empty Houses, Houses Cut off, and Bad Debts.	Net Water Rents.	Miscellaneous Receipts, Rent of Lands, &c.	Total Income.
31st March,	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	1,498,000	891,580	...	235,950	1,127,530	6,065	1,133,595	370,470	1,094,722	38,873	...	1,133,595	119,475 18 8	9,458 12 9	110,017 5 11	57 16 4	110,075 2 3
1875	1,498,000	953,650	...	233,350	1,187,000	6,065	1,193,065	311,000	1,171,966	21,099	...	1,193,065	123,935 0 1	9,580 18 5	114,354 1 8	60 16 9	114,414 18 5
1876	1,498,000	1,046,781	...	210,015	1,256,796	6,065	1,262,861	241,204	1,255,826	7,035	...	1,262,861	128,702 4 6	9,102 5 5	119,599 19 1	69 18 6	119,669 17 7
1877	1,450,000	1,107,987	...	195,965	1,303,952	6,065	1,310,017	146,048	1,299,212	10,805	...	1,310,017	135,852 18 3	9,070 8 6	126,782 9 9	107 11 6	126,890 1 3
1878	1,559,500	1,108,075	...	207,165	1,315,240	6,065	1,321,305	244,260	1,325,660	...	4,355	1,325,660	141,483 1 0	9,245 16 0	132,237 5 6	112 1 0	132,349 6 6
1879	1,559,500	1,108,075	...	238,845	1,346,920	6,065	1,352,985	212,580	1,340,863	12,122	...	1,352,985	146,488 11 8	8,434 0 11	138,054 10 9	79 12 6	138,134 3 3
1880	1,572,815	1,182,860	..	214,055	1,396,915	6,065	1,402,980	175,900	1,390,874	12,106	...	1,402,980	152,899 4 0	7,477 11 2	145,421 12 10	103 8 6	145,525 1 4
1881	1,573,088	1,226,667	...	209,055	1,435,722	6,065	1,441,787	137,366	1,435,766	6,021	...	1,441,787	164,523 9 10	10,166 18 1	154,356 11 9	115 18 3	154,472 10 0
1882	1,573,634	1,286,764	...	173,955	1,460,719	6,065	1,466,784	112,915	1,471,752	...	4,968	1,471,752	174,213 13 8	9,785 4 5	164,428 9 3	164 0 5	164,592 9 8
1883	1,574,180	1,312,909	...	173,955	1,486,864	6,065	1,492,929	87,316	1,505,754	...	12,825	1,505,754	186,008 18 8	11,146 17 7	174,862 1 1	157 12 6	175,019 13 7
Total . . .	...	...	...	...	...	...	...	...	...	...	...	...	1,473,583 0 10	93,468 13 3	1,380,114 7 7	1,028 16 3	1,381,143 3 10

For Year ending,	EXPENDITURE ON MAINTENANCE.										EXPENDITURE ON MANAGEMENT.									
	Maintenance of Reservoirs, Filtering Beds, Works, and Pipes for Storing Water.	Maintenance of Mains, &c., Meters, and Works connected with Distribution, including Renewals.	Pumping and Engine Charges, including Coals.	Filtration.	Salaries of Engineer and Clerks, and Wages of Inspector and Turncocks.	Rents owing by the Company.	Thames Conservancy.	Rates and Taxes.	Compensations, Premises and Mills; Superannuations and Law Expenses connected with Maintenance.	Total Expenditure on Maintenance.	Directors.	Company's Auditors.	Secretary, Accountant and Clerks.	Superannuation	Collectors.	General Establishment Charges.	Law and Parliamentary.	Official Auditor and Water Examiner.	Total Expenditure on Management.
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	2,272 11 5	6,094 15 4	20,544 9 7	1,025 2 8	4,584 3 9	223 15 0	1,250 0 0	5,782 17 9	...	41,777 15 6	1,215 0 0	31 17 10	1,501 13 8	...	2,530 9 6	464 7 6	423 4 5	108 18 2	6,335 11 1
1875	2,038 0 1	6,103 5 1	19,156 12 3	1,002 9 0	4,687 1 11	223 15 0	1,252 0 0	5,574 15 2	...	40,037 18 6	1,210 0 0	31 15 2	1,581 6 8	...	2,724 17 11	543 8 2	371 13 8	121 7 4	6,584 8 11
1876	1,938 12 8	6,843 15 7	20,575 7 5	990 3 4	4,848 9 3	223 15 0	1,251 0 0	5,159 16 7	...	41,830 19 10	1,210 0 0	31 15 2	1,642 12 9	...	2,821 9 1	535 14 2	405 17 3	134 14 11	6,782 3 4
1877	1,526 11 3	7,514 19 6	20,750 13 8	1,072 9 0	5,106 18 4	223 15 0	1,252 0 0	7,833 4 7	...	45,280 11 4	1,822 10 0	63 15 8	1,717 15 0	...	3,069 1 11	569 5 8	1,011 7 8	138 14 5	8,392 10 4
1878	1,248 16 5	7,680 3 11	18,989 6 6	1,108 6 4	5,203 3 11	273 15 0	1,252 0 0	6,705 12 7	...	42,461 4 8	1,822 10 0	63 15 8	1,687 2 6	964 12 6	3,767 1 9	700 17 1	235 10 6	138 17 3	9,380 7 3
1879	2,019 13 4	10,414 19 11	20,294 18 4	1,075 0 11	5,397 17 0	261 5 0	2,002 0 0	7,355 3 2	...	48,820 17 8	1,837 10 0	64 6 2	1,970 12 6	934 14 2	3,333 0 7	607 18 9	589 1 9	137 3 1	9,474 7 0
1880	1,603 11 8	10,363 19 2	18,943 11 2	1,165 18 8	5,708 3 4	211 15 0	2,252 0 0	7,517 7 0	...	47,766 6 0	1,837 10 0	64 6 2	1,905 4 2	929 14 2	3,532 9 4	728 17 6	1,712 13 0	139 5 10	10,850 0 2
1881	1,752 8 2	12,367 2 4	20,951 2 11	1,253 9 5	5,739 16 2	211 5 0	2,252 0 0	7,971 9 9	...	52,498 13 9	1,845 0 0	53 16 3	1,753 0 0	1,123 7 6	3,882 6 10	770 17 3	3,790 6 2	140 15 10	13,359 9 10
1882	2,520 14 1	12,124 12 4	23,483 15 11	1,276 15 0	5,554 0 5	211 5 0	2,252 0 0	10,224 13 7	...	57,647 16 4	1,837 10 0	53 11 10	2,090 5 5	1,579 2 6	4,014 18 4	668 11 5	431 17 9	148 16 10	10,824 14 1
1883	3,614 5 0	12,376 13 10	23,751 13 5	1,374 12 6	5,533 10 11	160 15 0	2,252 0 0	10,541 18 5	...	59,605 9 1	1,848 15 0	64 14 0	2,146 15 1	1,614 11 2	4,124 16 9	688 3 2	928 8 1	157 11 6	11,573 14 9
Total. . .	20,535 4 1	91,884 7 0	207,441 11 2	11,344 6 10	52,363 5 0	2,225 0 0	17,267 0 0	74,666 18 7	...	477,727 12 8	16,486 5 0	523 13 11	18,056 7 9	7,146 2 0	33,800 12 0	6,278 0 8	9,900 0 3	1,366 5 2	93,557 6 9

For Year ending	Total Expenditure on Maintenance and Management.	Profit on Trading.	Interest Paid on Preference, and Debenture Stocks and Loans, less Interest on Deposits, &c.	Net Profit.	Dividends paid on Ordinary Shares.	Surplus.	Deficiency.	Contingency Fund.	
								Taken from	Carried to
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	48,113 6 7	61,961 15 8	10,823 6 3	51,138 9 5	50,281 11 5	856 18 0	...	2,250 7 5	..
1875	46,622 7 5	67,792 11 0	11,416 16 3	56,375 14 9	53,758 19 9	2,616 15 0	...	...	...
1876	48,613 3 2	71,056 14 5	9,413 17 11	61,642 16 6	66,041 0 5	1,601 16 1	...	...	...
1877	53,673 1 8	73,216 19 7	8,773 2 5	64,443 17 2	66,297 16 8	...	1,853 19 6	3,000 0 0	...
1878	51,841 11 11	80,507 14 7	8,848 12 2	71,659 2 5	69,273 9 11	2,385 12 6	...	...	...
1879	58,295 4 8	79,838 18 7	9,032 18 9	70,805 19 10	69,326 15 7	1,479 4 3	...	..	2,500 0 0
1880	58,616 6 2	86,908 15 2	9,113 11 0	77,795 4 2	71,053 10 2	6,741 14 0	..	...	581 18 3
1881	65,858 3 7	88,614 6 5	8,886 10 3	79,727 16 2	79,190 10 6	537 5 8	...	...	...
1882	68,472 10 5	96,119 19 3	8,615 0 5	87,504 18 10	84,347 4 9	3,157 14 1	...	...	. .
1883	71,179 3 10	103,840 9 9	7,687 6 5	96,153 3 4	90,963 14 11	5,189 8 5	...	...	...
Total.	571,284 19 5	809,858 4 5	92,611 1 10	717,247 2 7	694,534 14 1	24,566 8 0	1,853 19 6	5,250 7 5	3,081 18 3

[H. 22.]

To face page 163.

Further statistical details relating to this Company's Works will be found in *Statistics of Supply*, *Table No.* 6 (*ante*, facing page 38), and concerning its Capital, Income, Expenditure, and Profits, in *Table No.* 6A, appended.

A map is also appended, shewing the parliamentary boundaries of the Company, the position of the principal works and direction of the mains, the district supplied, and the area under constant supply, which are distinguished by different shadings.

VII.—THE LAMBETH WATERWORKS.

THESE works were originally established under an Act of Parliament passed in the year 1785—"For supplying the inhabitants of Lambeth and parts adjacent with water from the river Thames, between Westminster Bridge and the confines of the parish of Christchurch."

The works thus sanctioned were erected in Belvedere Road, on a small piece of ground bordering on the river, close to the southern end of the footway over the present Charing Cross railway bridge, and consisted of a pumping engine of 20 horse-power, with wooden pipes laid therefrom into the district, by which the water was pumped directly from the river into the cisterns of the consumers.

The portion of the water district above widely defined under the Act, situated adjacent to the works, was at that time expanding and forming into a densely populated locality.

A large area of St. Mary, Lambeth, and the contiguous parishes, lay at comparatively low levels, comprising many fields and a good deal of garden ground, which in the rainy seasons were often covered with water, and in the winter frequently afforded the diversion of skating to thousands. The names of many of the places to this day indicate that they were situated on marsh lands with raised roads, or causeways, running through them ; thus, Lambeth Marsh was bounded by the parish of Christchurch and the Westminster and Blackfriars Roads. The area known by the name of St. George's Fields was bounded on the south by Newington Causeway, on the west by St. George's Road, on the north and west by the parishes of Lambeth and Christchurch, and on the north-east by Great Suffolk

Street, formerly called "Dirty Lane." Not far removed from the southern foot of Blackfriars Bridge, the Upper Ground, Broadwall, and Narrowwall, were roads raised above the flood waters of that locality, and the ordinary spring tides of the Thames. Near the foot of Waterloo Bridge was the site of Cupars Bridge—which crossed a low place and watercourse, known afterwards as the Arnold outlet, subsequently converted into a covered sewer, which drained a large tract of swampy land, comprising what is now York Road, and the lands, east, west, and south, for a considerable distance. Excepting some parts of the public roads, the natural surface of the greater portion of these districts was, and still is, under the ordinary high water-mark of the Thames; in some places, as much as five feet.

The population, except in the part above referred to, was at first thin, the principal portion of it being scattered on and contiguous to a line of street running from the foot of Blackfriars Bridge, in a direction nearly parallel to the Thames, to the foot of Westminster Bridge. From the widening and improvement of this great thoroughfare, now known as the Commercial and Belvedere Roads, the wharf property has become extremely valuable, and only a small relic of this ancient street or road now remains, viz.—the south end of Pedlar's Acre. Further to the south, Stangate, Church Street, Fore Street, and Princes Street had been built, the immediate neighbourhood of Lambeth Palace having been improved by embankments, and inhabited many years previously. Large tracts of land in Lambeth, subject to inundations from the river, had been in a state of saturation for centuries; and as buildings advanced, the stagnant pools and ditches became receptacles for filth and sewage water, which so affected and percolated through the soil, that the wells sunk into the land springs became unfit for domestic uses, and many which previously furnished good water, were obliged to be abandoned.

Prior to the year 1810, the southern Metropolitan suburbs derived little benefit from artificial drainage or underground sewers, the Commissioners of Sewers for Surrey,

&c., not having been invested with powers to make such works until they obtained an Act for that purpose in 1809. Their operations afterwards had a most beneficial influence, and rendered many swampy places fit for building sites, among which may be noticed the large area of Prince's Meadow and St. George's Fields, which prepared the way for the erection of Bethlehem Hospital and many large buildings, such as otherwise could never have been erected in that locality.

It is also worthy of notice that the construction of Waterloo Bridge, and the formation of the road from it to the Obelisk, acted as a stimulus to builders to improve and extend their operations.

From the early history of the Lambeth Waterworks Company's progress, it appears the proprietors contended with difficulties for a long time ; and at various periods (in the whole amounting to nearly twenty years) no dividends were paid by the Company, necessity having compelled them to expend the whole receipts on the works and to carry on the undertaking with the most rigid and even parsimonious economy.

Down to the year 1810 the improvement of the works had been progressive, but the extension of the supply was slow. At this period, however, an impetus was given to building operations in Lambeth and parts adjacent, by the drainage operations above referred to, which were carried out on a large scale, leading to a rapid increase in population. This called for the construction of water works of an enlarged and improved character, and the Company were not slow to meet the demands of the rising community.

Between 1810 and 1825 the works were considerably extended, that is, additional engine power was erected at the Belvedere Road station, and the pumping mains and service pipes were extended, cast-iron instead of wood pipes having been introduced about the year 1820. Improved means were also adopted for straining the water through screens before entering the engine wells, although at this period no attempt had been made at filtration.

About 1832 an open reservoir was constructed on Streatham Hill, and a 20-inch cast-iron main was laid from the Belvedere Road works to supply it, with the view of ensuring a constantly-available service of water in case of fire (water being only obtainable previously when the pumping engines were at work), and also to supply houses in Brixton and its vicinity at a higher level than that to which the water had previously been conveyed.

In 1834 the Company obtained a second Act of Parliament for increasing their powers, and under such Act two large open reservoirs, of 12,000,000 gallons capacity, were, about 1835, erected at Brixton on the extensive area of land on which the present town pumping station has since grown up.

The reservoirs were made in duplicate to contain a depth of about twenty feet of water, the upper fourteen feet only being drawn off for use, while the lower portion served for collecting the grosser impurities subsiding out of the water, the sullage being run to waste occasionally into the drains. In addition to this means of improving the condition of the water before service, each reservoir had a separate compartment walled off at the end, which was filled with a stratum of gravel four feet thick, through which the water was strained before use.

At this period a small pumping engine was erected at Brixton, to pump the improved water to Streatham reservoir, and one also at Streatham to provide additional supplies for the more elevated portions of the district beyond the reach of the service from the Streatham reservoirs. The works were generally much extended and improved, to meet the constantly-increasing demand for water, and also to enable the Company to afford high service supplies, including water-closets, which were at this period beginning to come into use.

The great increase in the population of the Metropolis obliged all the Water Companies to keep extending their areas of supply, and in several places, particularly in the Lambeth district, over which the Southwark and Vauxhall had and have joint powers, competition for the fresh supplies was set up so as to produce loss to the Companies and inconvenience to the consumers. Consequently, in or about 1841, all the Companies agreed to define their boundaries, and the competition between the Lambeth and Southwark Companies has since practically ceased by mutual agreement.

About 1845 The Health of Towns Commission was appointed, and the better drainage of London became a prominent question. The cesspool system, hitherto almost universal, began to be abolished as drainage by sewers was extended, and the foul matter hitherto stored under the ground surface of the Metropolis began to be gradually transferred to the Thames.

Hence in a year or two the river, from being a comparatively pellucid stream, became itself a polluted sewer on an enormous scale; the mass of tidal water, black and foul, passing continually up and down, thus creating a condition of things which culminated in the cholera outbreaks of 1845 and 1849.

It soon became evident that the Water Companies could not continue to draw water from the tidal way, and in 1847 the Lambeth Company took the initiative, by preparing an extensive scheme for removing their intake works to Thames Ditton, a mile or two above Kingston Bridge, obtaining in the following year (1848) an Act to sanction such works, and to enlarge the Company's district and confer other general powers.

By this Act the district was extended to include the parishes of Thames Ditton, Long Ditton, Kingston-on-Thames, Malden, Putney, Wimbledon, Morden, Merton, Mitcham, Tooting, Clapham, Wandsworth, Battersea, Streatham, Croydon, Newington Butts, St. Mary Newington, Camberwell, Bermondsey, St. Mary Lambeth, Rotherhithe, Horselydown, St. Saviour, St. George the Martyr, Christ Church, St. Olave, St. Thomas and the Clink Liberty. By the subsequent Act of 1872, the outlying portions of Esher, and East and West Molesey were added, whereupon the supply was extended to them. Thus the district is of very large dimensions, stretching over 17 miles from east to west, and 11½ miles from north to south, embracing an area of about 100 square miles.

The works sanctioned under the Act of 1848 consisted of a new intake, with a series of sand filters, from and adjoining to the river at Thames Ditton, together with the erection of four pumping engines of 600 horse power in all, with boilers, buildings, coal stores, and machinery for landing and depositing the coals. Also offices, workshops, and all the minor works and details connected with such an establishment.

A cast-iron main pipe of 30 inches diameter, and over 10 miles in length, was also laid down from the engine wells to the reservoirs at Brixton. Of this length, 6 miles were laid in public roads, and 4 miles through land, a sufficient width of the latter having been purchased to accommodate four such mains for future use.

These works were completed by the end of 1850, and were capable of delivering 10 million gallons of water per day into the Brixton reservoirs, this new supply being introduced early in January, 1851.

The quantity of water distributed by the Lambeth Company in 1831, averaged about 800,000 gallons per day; the service being intermittent, and the water turned on to different portions of the district supplied for about an hour per day for three days in the week.

In 1836, the quantity had increased to 2 million gallons per day, and at the date of the opening of the new works, in 1851, had got up to three million gallons.

When, however, the new water, of greatly improved quality was introduced, the consumption rapidly went up to 4½ million gallons per day in 1852, and has continued to increase at the rate of about half a million gallons per day per year to the present time; the average supply now amounting to about 16 million gallons per day.

Since the opening of the new works in 1851, to the present time, the increase of population, especially in the country district, has been so rapid that scarcely a year has passed without the necessity arising for making large and costly new works to keep pace with the ever-increasing demand for water.

The opening of the Crystal Palace, in 1854, gave a great stimulus to building operations, and a considerable resident population sprang up in Dulwich, Upper Norwood, Sydenham Hill, Forest Hill, and the adjoining high level localities. Works for the supply of these places were constructed by the Lambeth Company, and were brought into use in 1856.

A pair of 30-horse power engines, with boilers, pumps, buildings and coal stores, were erected at the Brixton station, and a 12-inch cast-iron main, 3½ miles in length, was laid to the high ground at Rock Hill, near to the Palace, where a covered service reservoir of 615,000 gallons capacity was constructed.

The water level of this reservoir is 363 feet above Ordnance datum, the engine-lift from Brixton being (with friction) 330 feet, and large service mains were laid to distribute the water.

Moreover, in order to give high supplies at the most elevated spots, a stand pipe was erected in a building of obelisk form, over which the water was forced some hours each day to a height of 415 feet above Ordnance datum, giving a corresponding pressure in the service pipes.

In the year 1852, the Metropolis Water Act was passed, making it illegal, after a certain time allowed for constructing new works, for any Company to supply water below Teddington Weir; for although the Lambeth Company had previously, as before described, voluntarily moved their intake far above this point, still several of the Companies continued at that period to use the river water within the tidal influence. Under this enactment the Chelsea, West Middlesex, Grand Junction, and Southwark Companies, all in a few years moved up the river, the first to Thames Ditton, adjoining the Lambeth works, and the latter three to Hampton. It was also under this Act ordered that all filtered water reservoirs within a radius of 5 miles from St. Paul's Cathedral should be covered over, and the Brixton and Streatham reservoirs of the Lambeth Company were accordingly, in 1855, covered with brick arches, supported on cross walls.

No greater improvement was ever effected in Waterworks construction than thus covering the reservoirs, and protecting the water from all atmospheric impurities, as well as from light and heat. In proof of the efficiency of this procedure, it may be mentioned that reservoirs, which when open required cleansing out twice a year, owing to the vegetable growth, aerial impurities, and animal life constantly accumulating therein, were found to be perfectly free from any objectionable deposit for five years after being covered over.

The Rock Hill works above described had not long been in operation before the lower levels south and east of the Crystal Palace, comprising Lower Norwood, Selhurst, Penge, and Lower Sydenham, were being rapidly built over, and to make provision for the supply of these parts with water, the Company carried out an extensive series of works between the years 1859 and 1861.

Brixton was again the base of operations, and two 60 horse-power engines, with all the necessary adjuncts, were erected there, and a pumping main, varying from 18 to 12 inches in diameter, and five miles in length, was laid to Selhurst, in South Norwood, where another covered service reservoir, of two-and-a-half-million gallons capacity, was constructed. The water was pumped through the 18-inch portion of the main to Streatham Reservoir, where an increased supply was furnished, while the residue continued on through the 12-inch main to Selhurst, and from thence a series of large service mains, with smaller distribution pipes, carried the water to the localities to be served.

The Selhurst Reservoir high water level is about 220 feet above Ordnance datum, while a loop pipe is laid underground up to a level of 260 feet, to act as a stand pipe to serve intermediate higher levels.

About this period, viz., in 1863, the town of Kingston-on-Thames required an improved water supply. To effect this, a reservoir was constructed in Coombe Warren, Kingston Hill, of 1,150,000 gallons capacity, and a 12-inch main, three miles long, was laid to fill it from the principal pumping station at Thames Ditton.

This arrangement has since been enlarged into a really separate water works, served by a special engine and entirely independent of the general works, and has been extended to supply not only the town of Kingston, but the populous neighbourhoods of Surbiton, Molesey, Esher and adjacent parts.

All these extensions of the water supplies were beginning to reach the safe limit of pumping power at Ditton, with reference to having sufficient spare power in reserve in case of accident ; and therefore, in 1864, two additional pumping engines, of 300 horse-power, with pumping wells, houses, and all other conveniences (of sufficient size to serve for duplicating the power in future), were erected at Ditton, together with further boilers and the necessary adjuncts, making a total at that period of 900 horse-power at this station.

In 1866 the extent of the water requirements had begun to exceed the power of production ; it being difficult, especially when the Thames was in flood, to filter the required quantity through the very limited sand area of the first filters ; and an extensive scheme, embracing a series of three subsidence reservoirs with an enlargement of the original filter-beds, was designed and carried out on the land fronting the river at Thames Ditton.

By means of these works the river water was first admitted from the river to the reservoirs, each of which was provided with a vertical gravel screen or rough filter at the draw-off end, similar to that before described at Brixton Reservoirs ; and after an interval of rest for subsidence, the water slowly passed through these screens out to the filters and thence to the engine wells.

Simultaneously with the enlargement of the Ditton

Works, arose the necessity for conveying the water to the town district, and the need for another main pipe to Brixton became evident. This meant an expenditure of £60,000. Yet the outlay was met, and a second 30-inch cast-iron main was laid, to convey the second ten million gallons per day to Brixton, all the land, not only for this but also for two other such mains, having been originally purchased. This work was completed in 1869, when it was thought that the works had become sufficient for a lengthened period; but it was soon evident that the requirements of the suburban district on the higher level served from Brixton were becoming of pressing necessity, and must be attended to.

The Lambeth Company at the latest date above cited were paying 5½ per cent to their shareholders. During 20 years of their earlier career they paid nothing.

To continue the recital of the extension of works. In 1870 it became necessary to re-arrange and enlarge the Brixton works, and three new engines, of 200 horse-power were added, to pump water to Rock Hill and the country district, with the necessary extension of mains and service pipes for that purpose.

The filters at Ditton also required enlargement, and the subsiding reservoirs, previously noticed, were converted into filters, as being more serviceable in that shape.

In 1871 new large mains were laid from Brixton to Selhurst, and in the same year, under the powers of a new Act obtained in 1871, the pipes were extended and a service of water afforded to the new outlying districts of Molesey and Esher, embraced in that Act.

The Act of 1871 was, however, specially applied for and obtained, for the purpose of removing the Company's in-take from Ditton to Molesey.

Notwithstanding the works hitherto described for improving the quality of the water, it was found that during river floods it could not be filtered clear and bright, chiefly owing to the stream of the Mole river, which joins the Thames below Hampton Court Bridge.

The Company therefore sought and obtained powers under that Act to remove their intake to West Molesey, more than four miles higher up the river, and proceeded at once to carry out the works.

The necessary land being purchased (about forty acres), the construction of the new intake from the Thames three miles above Hampton Court Bridge was completed, and an underground conduit, over four miles in length, from the intake passing through West and East Molesey and Thames Ditton to the existing works at Ditton, was constructed, capable of conveying thereto twenty million gallons of water per day by gravitation.

The new intake is furnished with double wire gauze screens, to prevent fish as well as leaves and other floating impurities entering the conduit; and a sluice house, with large screw sluices, is constructed on the adjoining land belonging to the Company, to control the flow of water.

The conduit consists of an oval-shaped structure, 5 feet 9 inches high and 4 feet 9 inches wide, with intervals of cast iron pipes 54 inches in diameter, the latter being laid through the towns of West and East Molesey and Thames Ditton, and the former through lands and country roads.

These works were completed in 1872, and a considerable improvement was effected thereby in the quality of the water, that of the river Mole being now quite avoided; but it was still evident that, during severe river floods, the water could not be effectually filtered, and steps were taken to construct the large store reservoirs adjoining the new intake, the works of which were completed early in 1875.

These reservoirs, two in number, are capable of holding 125 million gallons of water; and the works embrace a pair of pumping engines of 100 horse-power, with engine and boiler houses, coal stores, cottages, and other minor works. The engines lift the river water into the reservoirs.

During the construction of the reservoirs, a very large volume of subsoil water, contained in the deep gravel bed overlying the London clay at that part, had to be encountered. This water being rain naturally filtered, and of great purity, was utilised by means of a double series of glazed stone-ware pipes, 12 to 24 inches diameter, perforated with small holes and laid along the river sides of the reservoirs, extending inland at the ends and between them, to conduct the water to the engine wells. This supply, to the extent of seven or eight million gallons per day, is used to replenish the store in the reservoirs during floods, when the river intake is entirely closed.

By these means the Company possess the power of tiding over a flood of eighteen to twenty days' duration, and by judicious pumping it is found that within such period the reservoirs when drawn down for service to Ditton can always be replenished with clear water, which has the advantage of being impounded for lengthened periods and exposed to the atmosphere in rest, to allow of the subsidence of matter held in suspension.

These extensions of the works from Ditton to Molesey, embracing the new intake, and including 35 acres of land, cost the Company near upon £180,000, which sum was expended wholly with the object of improving the quality of the water.

In 1881 a further extension of the filters and works at Ditton was effected.

The extension comprised a service reservoir of 3,000,000 gallons, with a series of 4 filters of 1 acre each, and a pair of engines of 140 horse-power, to pump from the lower level of the earlier filters adjoining the river to the service reservoir; conduits, engines, and boiler houses, boundary walls and other necessary works, also being constructed in connection therewith.

These new filters bring the total sand-filtering area up to nearly eight acres in extent; but it may be stated that the Company possess sufficient spare land for the construction of four acres additional filtering area when required.

Since the completion of the Molesey extension, and in addition to the above-named reservoirs and engines, the

Company have carried out the following works and extensions, viz.:—

In 1875 the erection of a pair of engines at Ditton of 300 horse-power.

Also in 1876 and 1877 the erection of a pair of combined engines of 130 and 160 horse-power respectively, with boilers, and buildings, to pump water to a new covered reservoir constructed at Crown Hill, Norwood, at a level of 315 feet above Ordnance datum, to hold 5,000,000 gallons of filtered water; together with about five miles of pumping and service mains, varying from twelve to eighteen inches in diameter.

The object of these extensions was to meet the increasing demands of the country district, and to improve the services in those parts lying at levels intermediate between Streatham and Rock Hill reservoirs, the parts so served being the upper portions of Dulwich, Norwood, Beckenham, Sydenham, Forest Hill, Ravensbourne Park, &c.

In 1875, a main 24 inches in diameter, and over three miles in length, was laid down from Brixton to near the Obelisk in Southwark, to supply more water at higher pressure generally, as well as with the view of commencing to carry out the system of constant supply. Between this date and 1880 large mains were laid in various parts of the district, viz.: one of 12 inches in diameter and 4 miles in length, from Norwood reservoir to Wimbledon, and one of the same size and 4½ miles in length, from the same reservoir to Beckenham, to increase the supply in that part of the district.

Since 1881, besides various pipe extensions, two engines have been erected at Brixton of, respectively, 120 and 130 horse-power; the first as a duplicate for safety to the engines supplying Rock Hill, and the second as a spare engine to pump to Selhurst and Norwood reservoirs, as well as a single engine, 180 horse-power, with boilers and building, just completed at Ditton. These works bring the extensions down to the present time, to which, however, must be added the laying of a third 30-inch main, over ten miles in length, from Ditton to Brixton, commenced in November last, and to be completed in 1885.

The stations (8 in number) and works thus described may be usefully summarised as follows :—

No. 1 station at Molesey. The new intake; the store reservoirs for river and spring water of 125,000,000 gallons capacity ; the pumping engines of 100 horse-power, and the conduit 4 miles long from the river to the Ditton works, capable of conveying thereto 20,000,000 gallons of water in 24 hours.

No. 2. The principal pumping station and old intake at Ditton ; filters of nearly 8 acres in extent ; 2 service reservoirs of 3,000,000 gallons capacity ; 12 pumping engines of 1550 horse-power ; offices, coal stores, and machinery for landing coals ; workshops, general stores, workmen's cottages and other buildings, and general pipe yard. Two cast-iron mains of 30-inch diameter and each 10¼ miles long, to deliver water into the Brixton reservoirs, and the third such main now being laid.

No. 3 station, Coombe, Kingston Hill. Covered reservoir for filtered water, of 1,150,000 gallons capacity. Pumping mains and turncock's cottage.

No. 4. Second lift pumping station at Brixton. Two covered reservoirs, holding 12,000,000 gallons of filtered water; 12 pumping engines of 930 horse-power; the Company's principal offices ; coal and general stores, stabling, workmen's residences, and pipe yards.

No. 5. Streatham station. Two covered reservoirs for filtered water, of 7,500,000 gallons capacity.

No. 6. Norwood station. Covered filtered water reservoir of 5,000,000 gallons capacity. Turncock's residence, etc.

No. 7. Rock Hill station. Covered filtered water reservoir of 615,000 gallons capacity, cast-iron tank of 100,000 gallons capacity elevated on a structure of brickwork and roofed over ; stand pipe to give additional pressure up to 415 feet above Ordnance datum for high service. Turncock's cottage, etc.

No. 8. Selhurst station. Filtered water covered reservoir of 2½ million gallons capacity, with spare land for a duplicate. Turncock's cottage, etc.

SUMMARY OF FILTERED WATER RESERVOIRS.

2 at	Brixton . . .	12,000,000	gallons capacity,	115 ft.	above Ordnance datum.
1 ,,	Combe . . .	1,150,000	,,	180 ft.	,, ,,
2 ,,	Streatham . .	7,500,000	,,	200 ft.	,, ,,
1 ,,	Norwood . .	5,000,000	,,	315 ft.	,, ,,
1 ,,	Selhurst. . .	2,500,000	,,	220 ft.	,, ,,
2 ,,	Rock Hill . .	615,000	,,	365 & 390 ft.	,, ,,
Total 9	containing	28,765,000	gallons.		

The entire district of the Company contains about 95 miles of main pipes, varying from 9 up to 30 inches in diameter, and about 540 miles of service pipes, from 3 up to 7 inches in diameter.

CAPITAL EXPENDITURE.

To the passing of the Act of 1848 . .	£143,800.
To the present time about	£1,550,000
Gross Revenue about	£190,000.

CONSTANT SUPPLY.

The Company are at present giving constant service to 29,536 houses, or 39 per cent. of the entire district; and in 28,564 of these the fittings prescribed by the Board of Trade regulations have been provided.

The Company have always given a constant supply (where the mains were constantly charged) upon the application of consumers who had provided the prescribed fittings, and otherwise complied with the Company's requirements. The number of such supplies in 1877 amounted to about 3000. The sanitary and other benefits that would accrue to the public by converting the intermittent into a constant supply, had not, however, been lost sight of by the directors of the Company, and the Board, on the advice of their engineer, having laid out very large works for the purpose, determined in 1878 to commence the adoption of the system generally throughout their district, proceeding gradually section by section. The results down to the present time are given in the following table, which relates only to the Company's town district:—

Division or District.		Date, when placed on Constant Supply.	Number of Waste Meter Districts.	Number of Supplies.	Population Supplied.
Town.	No. 1 . . .	Oct. 1, 1878	6	2,216	16,112
	No. 2 . . .	Jan. 1, 1880	20	7,404	61,538
	No. 3 . . .	July 1, 1881	12	4,337	34,016
	No. 4 · . .	Oct. 1, 1882	6	1,835	14,752
	No. 5 . . .	May 1, 1883	9	3,900	29,912
	No. 6 . . .	Nov. 1, 1883	6	2,919	23,350
	No. 7 . . .	April 2, 1884	1	290	2,320
Country A. . .		July 1, 1882	3	1,534	12,224
Coventry Park .		June 1, 1882	1	180	1 440
Totals . .		..	64	24,615	195,664

The above divisions include the whole of the Company's town district, extending northward to the river Thames from a line drawn from Vauxhall Bridge by Kennington Church and Camberwell New Road to Camberwell Green, comprising the poorest and most densely populated part of their district.

Notices have been served, in accordance with the Metropolis Water Act 1871, on the Metropolitan Board of Works, for three more divisions of constant supply, the particulars of which are given below.

Division or District.	Number of Supplies.	Proposed Date of Constant Supply.
No. 8.	1,534	Oct. 1, 1884.
No 9.	3,517	Jan. 1, 1885.
Country B.	3,757	April 1, 1885.
Total . . .	8,808	..

By the beginning of April 1885, 38,344, or nearly half the houses in the Company's entire district, will be receiving the benefits of a constant supply of water at high pressure.

The satisfactory results that have been thus obtained for the public have entailed considerable expense on the Company, and also in many cases great difficulty in forcing the owners of small property to provide the prescribed fittings.

Shortly after the first district was placed on constant supply, it was found that the waste of water through defective fittings and house service pipes was so great, in some parts amounting to 30 and 40 gallons per head per day, that the system could not be extended except at a ruinous cost to the Company. It was also found that the ordinary house to house inspection of fittings was quite inadequate to check the waste, the greater part of which was hidden or underground. It therefore became a matter of vital importance to adopt some means to prevent this great loss, so that the system of constant service could be extended at a moderate cost to the Company.

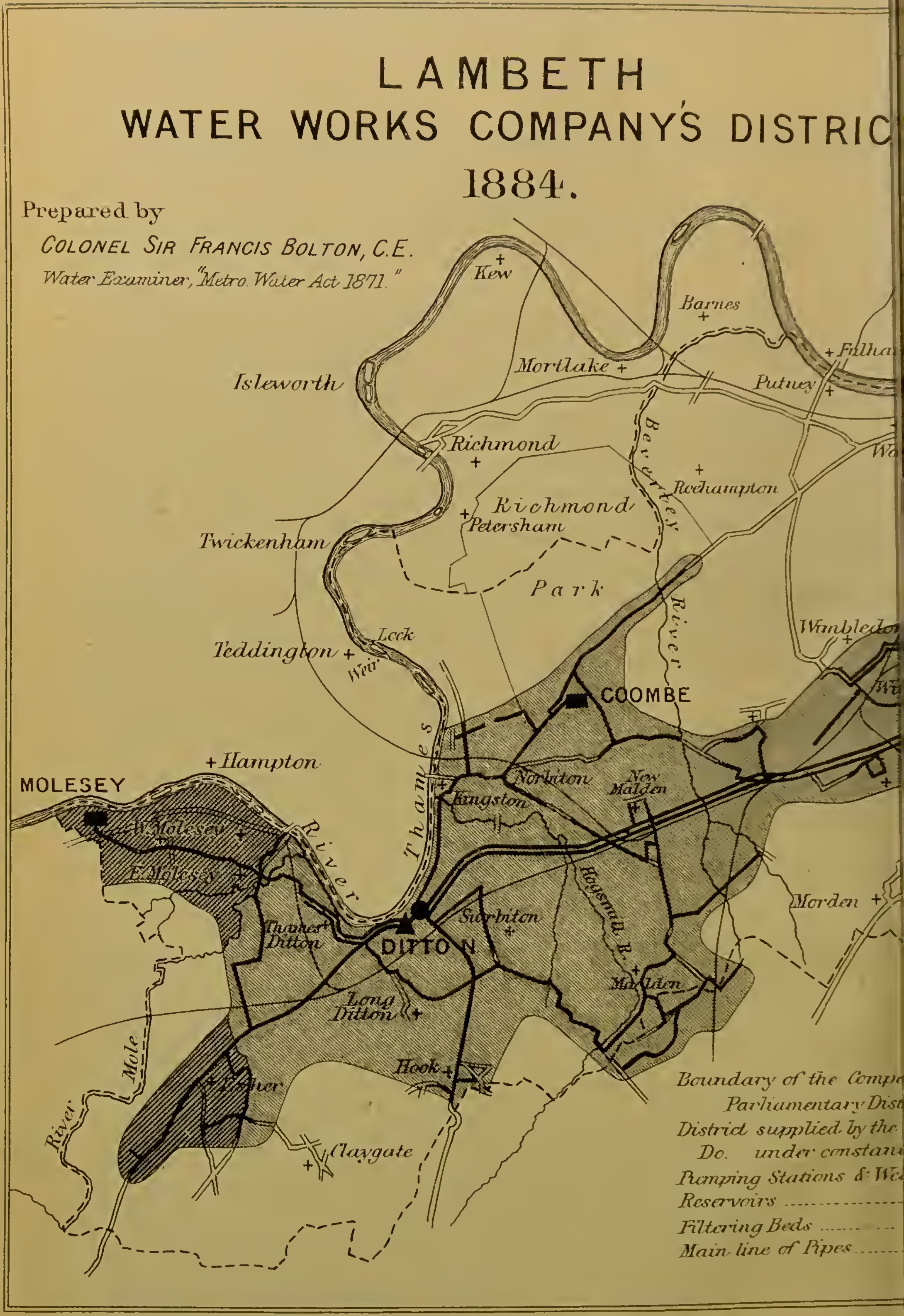
The attention of the directors was drawn to the system of waste-detecting meters patented by Mr. Deacon, the engineer of the Liverpool Corporation, and it having been found that the system worked effectually in Liverpool, it was introduced into the Lambeth Company's district in 1879.

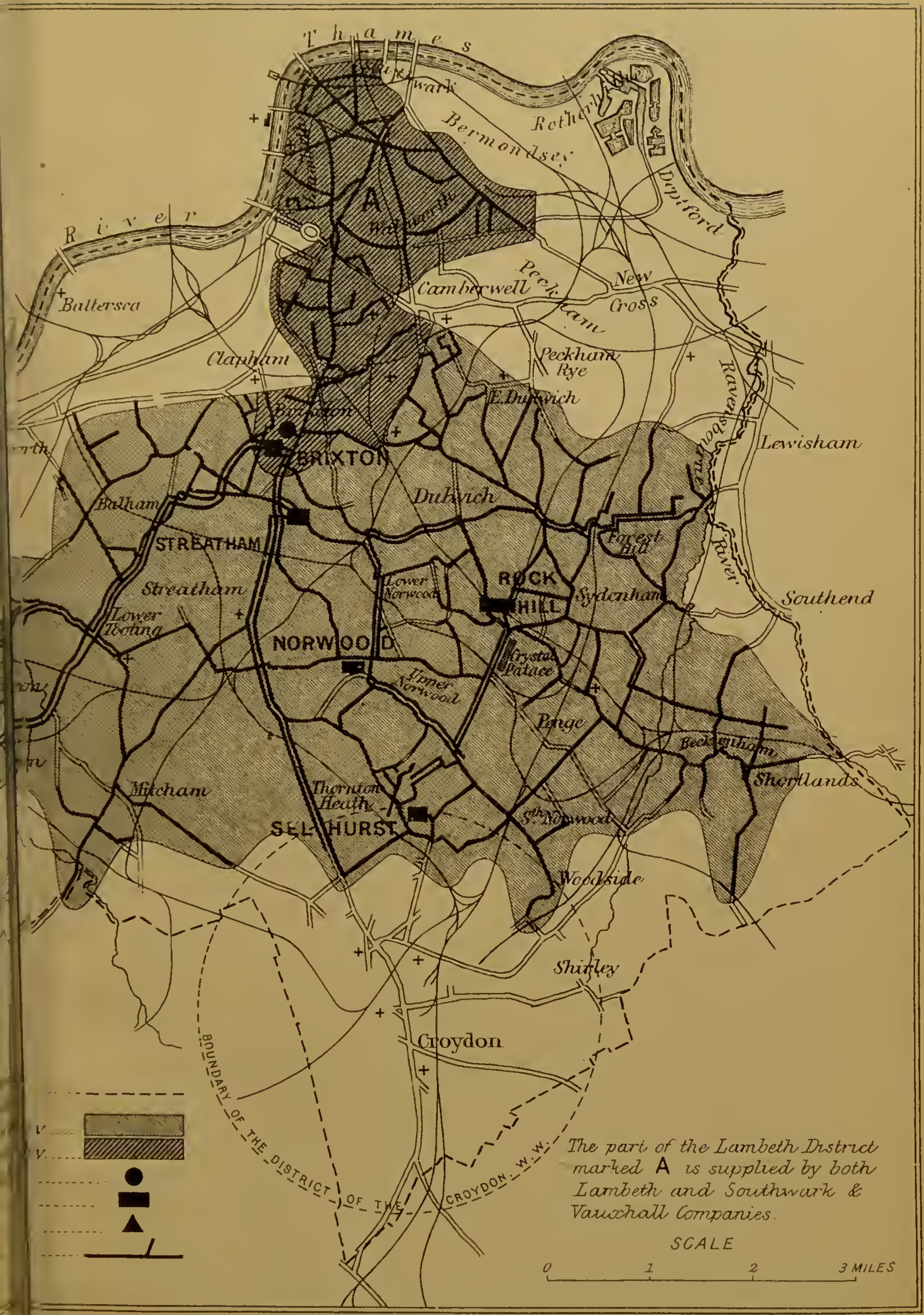
The adoption of this system has proved of such effect in the prevention and suppression of waste, that the Company have been enabled to extend the area of constant supply by regular sections; and at the present time, 64 meters, supplying 24,615 houses, with a population of nearly 200,000 persons, are fixed and in full working order.

Up to the 31st of March last, the results of the system have been that constant supply is being given on two of the divisions at 16 and 18 gallons per head per day, the average for the population of 200,000 persons being 20·51 gallons, as compared with 35·09 gallons before Deacon's meters were introduced, and there can be no doubt that

LAMBETH
WATER WORKS COMPANY'S DISTRIC
1884.

Prepared by
COLONEL SIR FRANCIS BOLTON, C.E.
Water Examiner, "Metro. Water Act 1871."





The part of the Lambeth District marked A is supplied by both Lambeth and Southwark & Vauxhall Companies.

James Wyld, 11 & 12 Charing Cross, London.

THE LAMBETH WATER WORKS COMPANY.

TABLE No. 7A.—Statement shewing the Capital authorised, raised and expended at the end of each year, together with the Income, Expenditure on Maintenance and Management, Profit on Trading, Interest paid, Net Profit, Dividends paid, &c., for each year, during a period of ten years.

Prepared (in connection with the International Health Exhibition of 1884) *for the Diagrams of* COLONEL SIR FRANCIS BOLTON, C.E., *Water Examiner under the "Metropolis Water Act,* 1871," *by* ALFRED LASS, F.C.A.

For Year ending	CAPITAL AUTHORISED, RAISED AND EXPENDED (at the end of each Year)												INCOME.				
		SHARE AND LOAN CAPITAL RAISED AND PREMIUMS RECEIVED.							CAPITAL EXPENDED AND EMPLOYED.								
										Capital in Hand or Overdrawn.							
	Share and Loan Capital authorised.	Ordinary Stocks and Shares.	Preference Stock	Bonds and Debentures.	Total Share and Loan Capital raised	Premiums received.	Total Share and Loan Capital raised and Premiums received.	Balance of Authorised Capital remaining to be raised.	Capital expended.	In Hand.	Overdrawn.	Capital employed.	Gross Water Rents.	Written off as Losses, for Empty Houses, Houses Cut off, and Bad Debts.	Net Water Rents.	Miscellaneous Receipts, Rent of Lands, &c.	Total Income.
31st March,	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	1,498,000	891,580	...	235,950	1,127,530	6,065	1,133,595	370,470	1,094,722	38,873	...	1,133,595	119,475 18 8	9,458 12 9	110,017 5 11	57 16 4	110,075 2 3
1875	1,498,000	953,650	...	233,350	1,187,000	6,065	1,193,065	311,000	1,171,966	21,099	..	1,193,065	123,935 0 1	9,580 18 5	114,354 1 8	60 16 9	114,414 18 5
1876	1,498,000	1,046,781	...	210,015	1,256,796	6,065	1,262,861	241,204	1,255,826	7,035	...	1,262,861	128,702 4 6	9,102 5 5	119,599 19 1	69 18 6	119,669 17 7
1877	1,450,000	1,107,987	...	195,965	1,303,952	6,065	1,310,017	146,048	1,299,212	10,805	...	1,310,017	135,852 18 3	9,070 8 6	126,782 9 9	107 11 6	126,890 1 3
1878	1,559,500	1,108,075	...	207,165	1,315,240	6,065	1,321,305	244,260	1,325,660	...	4,355	1,325,660	141,483 1 6	9,245 16 0	132,237 5 6	112 1 0	132,349 6 6
1879	1,559,500	1,108,075	...	238,845	1,346,920	6,065	1,352,985	212,580	1,340,863	12,122	...	1,352,985	146,488 11 8	8,434 0 11	138,054 10 9	79 12 6	138,134 3 3
1880	1,572,815	1,182,860	...	214,055	1,396,915	6,065	1,402,980	175,900	1,390,874	12,106	...	1,402,980	152,899 4 0	7,477 11 2	145,421 12 10	103 8 6	145,525 1 4
1881	1,573,088	1,226,667	...	209,055	1,435,722	6,065	1,441,787	137,366	1,435,766	6,021	...	1,441,787	164,523 9 10	10,166 18 1	154,356 11 9	115 18 3	154,472 10 0
1882	1,573,634	1,286,764	...	173,955	1,460,719	6,065	1,466,784	112,915	1,471,752	...	4,968	1,471,752	174,213 13 8	9,785 4 5	164,428 9 3	164 0 5	164,592 9 8
1883	1,574,180	1,312,909	...	173,955	1,486,864	6,065	1,492,929	87,316	1,505,754	...	12,825	1,505,754	186,008 18 8	11,146 17 7	174,862 1 1	157 12 6	175,019 13 7
Total . . .	...	...	...	...	...	...	...	...	...	...	...	...	1,473,583 0 10	93,468 13 3	1,380,114 7 7	1,028 16 3	1,381,143 3 10

For Year ending,	EXPENDITURE ON MAINTENANCE.										EXPENDITURE ON MANAGEMENT.								
	Maintenance of Reservoirs, Filtering Beds, Works, and Pipes for Storing Water.	Maintenance of Mains, &c., Meters, and Works connected with Distribution, including Renewals.	Pumping and Engine Charges, including Coals.	Filtration.	Salaries of Engineer and Clerks, and Wages of Inspector and Turncocks.	Rents owing by the Company.	Thames Conservancy.	Rates and Taxes.	Compensations, Premises and Mills; Superannuations and Law Expenses connected with Maintenance.	Total Expenditure on Maintenance.	Directors.	Company's Auditors.	Secretary, Accountant and Clerks.	Superannuation	Collectors.	General Establishment Charges.	Law and Parliamentary.	Official Auditor and Water Examiner.	Total Expenditure on Management.
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	2,272 11 5	6,094 15 4	20,544 9 7	1,025 2 8	4,584 3 9	223 15 0	1,250 0 0	5,782 17 9	...	41,777 15 6	1,215 0 0	31 17 10	1,561 13 8	...	2,530 9 6	464 7 6	423 4 5	108 18 2	6,335 11 1
1875	2,038 0 1	6,103 5 1	19,156 12 3	1,002 9 0	4,687 1 11	223 15 0	1,252 0 0	5,574 15 2	...	40,037 18 6	1,210 0 0	31 15 2	1,581 6 8	...	2,724 17 11	543 8 2	371 13 8	121 7 4	6,584 8 11
1876	1,938 12 8	6,843 15 7	20,575 7 5	990 3 4	4,848 9 3	223 15 0	1,251 0 0	5,159 16 7	...	41,830 19 10	1,210 0 0	31 15 2	1,642 12 9	...	2,821 9 1	535 14 2	405 17 3	134 14 11	6,782 3 4
1877	1,526 11 3	7,514 19 6	20,750 13 8	1,072 9 0	5,106 18 4	223 15 0	1,252 0 0	7,833 4 7	.	45,280 11 4	1,822 10 0	63 15 8	1,717 15 0	..	3,069 1 11	569 5 8	1,011 7 8	138 14 5	8,392 10 4
1878	1,248 16 5	7,680 3 11	18,989 6 6	1,108 6 4	5,203 3 11	273 15 0	1,252 0 0	6,705 12 7	...	42,461 4 8	1,822 10 0	63 15 8	1,687 2 6	964 12 6	3,767 1 9	700 17 1	235 10 6	138 17 3	9,380 7 3
1879	2,019 13 4	10,414 19 11	20,294 18 4	1,075 0 11	5,397 17 0	261 5 0	2,002 0 0	7,355 3 2	...	48,820 17 8	1,837 10 0	64 6 2	1,970 12 6	934 14 2	3,333 0 7	607 18 9	589 1 9	137 3 1	9,474 7 0
1880	1,603 11 8	10,363 19 2	18,943 11 2	1,165 18 8	5,708 3 4	211 15 0	2,252 0 0	7,517 7 0	...	47,766 6 6	1,837 10 0	64 6 2	1,905 4 2	929 14 2	3,532 9 4	728 17 6	1,712 13 0	139 5 10	10,850 0 2
1881	1,752 8 2	12,367 2 4	20,951 2 11	1,253 9 5	5,739 16 2	211 5 0	2,252 0 0	7,971 9 9	...	52,498 13 9	1,845 0 0	53 16 3	1,753 0 0	1,123 7 6	3,882 6 10	770 17 3	3,790 6 2	140 15 10	13,359 9 10
1882	2,520 14 1	12,124 12 4	23,483 15 11	1,276 15 0	5,554 0 5	211 5 0	2,252 0 0	10,224 13 7	...	57,647 16 4	1,837 10 0	53 11 10	2,090 5 5	1,579 2 6	4,014 18 4	668 11 5	431 17 9	148 16 10	10,824 14 1
1883	3,614 5 0	12,376 13 10	23,751 13 5	1,374 12 6	5,533 10 11	160 15 0	2,252 0 0	10,541 18 5	...	59,605 9 1	1,848 15 0	64 14 0	2,146 15 1	1,614 11 2	4,124 16 9	688 3 2	928 8 1	157 11 6	11,573 14 9
Total. . .	20,535 4 1	91,884 7 0	207,441 11 2	11,344 6 10	52,363 5 0	2,225 0 0	17,267 0 0	74,666 18 7	...	477,727 12 8	16,486 5 0	523 13 11	18,056 7 9	7,146 2 0	33,800 12 0	6,278 0 8	9,900 0 3	1,366 5 2	93,557 6 9

For Year ending	Total Expenditure on Maintenance and Management.	Profit on Trading.	Interest Paid on Preference, and Debenture Stocks and Loans, less Interest on Deposits, &c.	Net Profit.	Dividends paid on Ordinary Shares.	Surplus.	Deficiency.	Contingency Fund.	
								Taken from	Carried to
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	48,113 6 7	61,961 15 8	10,823 6 3	51,138 9 5	50,281 11 5	856 18 0	...	2,250 7 5	...
1875	46,622 7 5	67,792 11 0	11,416 16 3	56,375 14 9	53,758 19 9	2,616 15 0	...	...	..
1876	48,613 3 2	71,056 14 5	9,413 17 11	61,642 16 6	60,041 0 5	1,601 16 1	...	..	...
1877	53,673 1 8	73,216 19 7	8,773 2 5	64,443 17 2	66,297 16 8	..	1,853 19 6	3,000 0 0	...
1878	51,841 11 11	80,507 14 7	8,848 12 2	71,659 2 5	69,273 9 11	2,385 12 6	...	...	.
1879	58,295 4 8	79,838 18 7	9,032 18 9	70,805 19 10	69,326 15 7	1,479 4 3	...	...	2,500 0 0
1880	58,616 6 2	86,908 15 2	9,113 11 0	77,795 4 2	71,053 10 2	6,741 14 0	...	..	581 18 3
1881	65,858 3 7	88,614 6 5	8,886 10 3	79,727 16 2	79,190 10 6	537 5 8	...	...	...
1882	68,472 10 5	96,119 19 3	8,615 0 5	87,504 18 10	84,347 4 9	3,157 14 1	...	...	...
1883	71,179 3 10	103,840 9 9	7,687 6 5	96,153 3 4	90,963 14 11	5,189 8 5	...	...	...
Total.	571,284 19 5	809,858 4 5	92,611 1 10	717,247 2 7	694,534 14 1	24,566 8 0	1,853 19 6	5,250 7 5	3,081 18 3

To face page 163.

when the new proposed constant supply districts are completed, and the meter system is extended to them, a still further reduction in the consumption will be effected, resulting in increased working pressure in the service pipes, which at present is about 94 feet, or 40 lbs. to the square inch, in the town district.

The average daily supply per head on the Company's whole district for the year ended March 31st last, was 29·85 gallons, as compared with 33·36 gallons, the mean average daily supply for the previous six years; while, as before stated, the present average consumption per head on the constant supply division amounts to 20·51 gallons. But the consumption can only be maintained at this low figure by continual inspection and supervision.

The present staff attending to this particular service consists of 1 superintendent, and 22 waste water inspectors (entailing an annual cost to the Company of about £2,300), who are exclusively employed on inspection of fittings and waste meters in the constant supply districts, and house to house inspection in the country districts, their whole time being occupied in preventing and suppressing waste. The staff have also to see that the prescribed fittings are provided, and that the Board of Trade regulations for avoiding contamination of the water supply are effectually carried out.

The Company have no wish to restrict the public in the legitimate use of water, but desire to provide an abundant supply and to encourage its use for all domestic and reasonable purposes, while taking measures to prevent actual waste.

Further statistical details relating to this Company's Works will be found in *Statistics of Supply*, *Table No.* 7 *ante*, facing page 38), and concerning its Capital, Income, Expenditure and profits, in *Table No.* 7A appended.

A map is also appended, showing the parliamentary oundaries of the Company, the position of the principal orks, and direction of the mains, the district supplied, and he area under constant supply, which are distinguished by fferent shadings.

VIII.—THE CHELSEA WATERWORKS.

THE first charter of the Chelsea Company was granted in 1723, the 9th year of the reign of George I. In 1726 a royal warrant was granted, authorising the Company to convert two ponds in St. James's Park into reservoirs, and in 1727 another warrant was obtained authorising the construction of a reservoir in Hyde Park.

The original capital of the Company was £40,000.

The works were situated on the north bank of the Thames at Chelsea, the supply being drawn direct from the river, and in this state distributed to the consumers. The first attempt to purify the water was by allowing the impurities to subside in settling reservoirs, but this not proving effective, filter-beds were designed and constructed, in 1829, by the Company's engineer, the late Mr. Simpson. This method of purification has also been adopted by all the London Companies not taking their supply from wells.

Owing to the growth of London, and the increased contamination of the water of the River Thames, it became necessary to seek a supply above the influence of the tide; and in 1852 an Act was obtained for moving the site of the works and intake to Surbiton, adjoining the new works of the Lambeth Water Company.

The Chelsea Company's new works, completed in 1856, consisted of two subsidence reservoirs, two filter-beds, four engines of an aggregate power of 600 horses, and a thirty-inch main to Putney Heath, where covered reservoirs were constructed with a capacity of about ten million gallons; whence the water was distributed to the district. An open reservoir was also constructed for the unfiltered water then used for road-watering. The distributing mains are carried across the river by an aqueduct a little above Putney Bridge.

By the same Act (1852) the Company were authorised to increase their capital from £300,000, at which it then stood, by the issue of £440,000 fresh capital. By their Act of 1864 they were authorised to raise an additional share capital of £328,750.

The periodical and increasing turbidity of the water caused by the floods from the river Mole, which flows into the Thames above the works at Surbiton, induced the Company in 1875 to apply for and obtain parliamentary powers, to remove their intake to a point higher up the river above the influence of the Mole and about half a mile below Sunbury Lock. By this Act (1875) the Company were authorised to raise further capital to the extent of £200,000. The total capital of the Company authorised by the various Acts of Parliament is £1,268,750.

The Company have now three stations, viz.:

1. Walton and West Molesey.
2. Surbiton.
3. Putney Heath.

1. *Walton and West Molesey.* The intake, on the south bank of the Thames, in the parish of Walton. The water has first to pass through an iron grating at the intake (guarded by a moveable wooden screen, so arranged as to prevent any accumulation of leaves and weeds from being drawn through the grating), and then through double fine wire screens into the covered wells, from which the water is pumped into the "regulating tank" (a lift of about 20 feet) by means of two steam engines, each of about 50 horse-power. From the "regulating tank" the water runs into any one of the four subsidence reservoirs. Each of these is capable of holding at least 35,000,000 gallons, the capacity of the four being 140,000,000: or, if necessary, the water can be delivered into the 36-inch conduit pipe and sent direct from the intake on to the filters at Surbiton, a distance of nearly five miles.

These additional works, which were constructed at a cost of £204,438, were brought into operation at the end of the year 1877.

2. *Surbiton.* Here the water is received from West Molesey for the purpose of undergoing the process of filtration. The filter-beds, originally two in number with an area of two acres, with 2 reservoirs of 3 acres area, were extended subsequently, and the reservoirs converted into filters, the latter being now 7 in number and the area 6¾ acres. Four or five of these are usually in operation at one time, the remainder being cleaned by the removal of the top layer of sand, which is washed, dried, and replaced.

The filtering medium is 8 feet in depth, and consists of 4 feet 6 inches of sand, coarse and fine, 3 inches of shells, and 3 feet 3 inches of stones of various sizes.

The water, after passing slowly through the filters, flows into the engine wells, whence it is lifted by pumps of the bucket and plunger description worked by compound engines of 150 horse-power each. These engines, originally four in number, were increased in 1866 to six, having an aggregate power of 900 horses. Foundations, and other preparatory works have also been provided for an additional pair of engines when necessary.

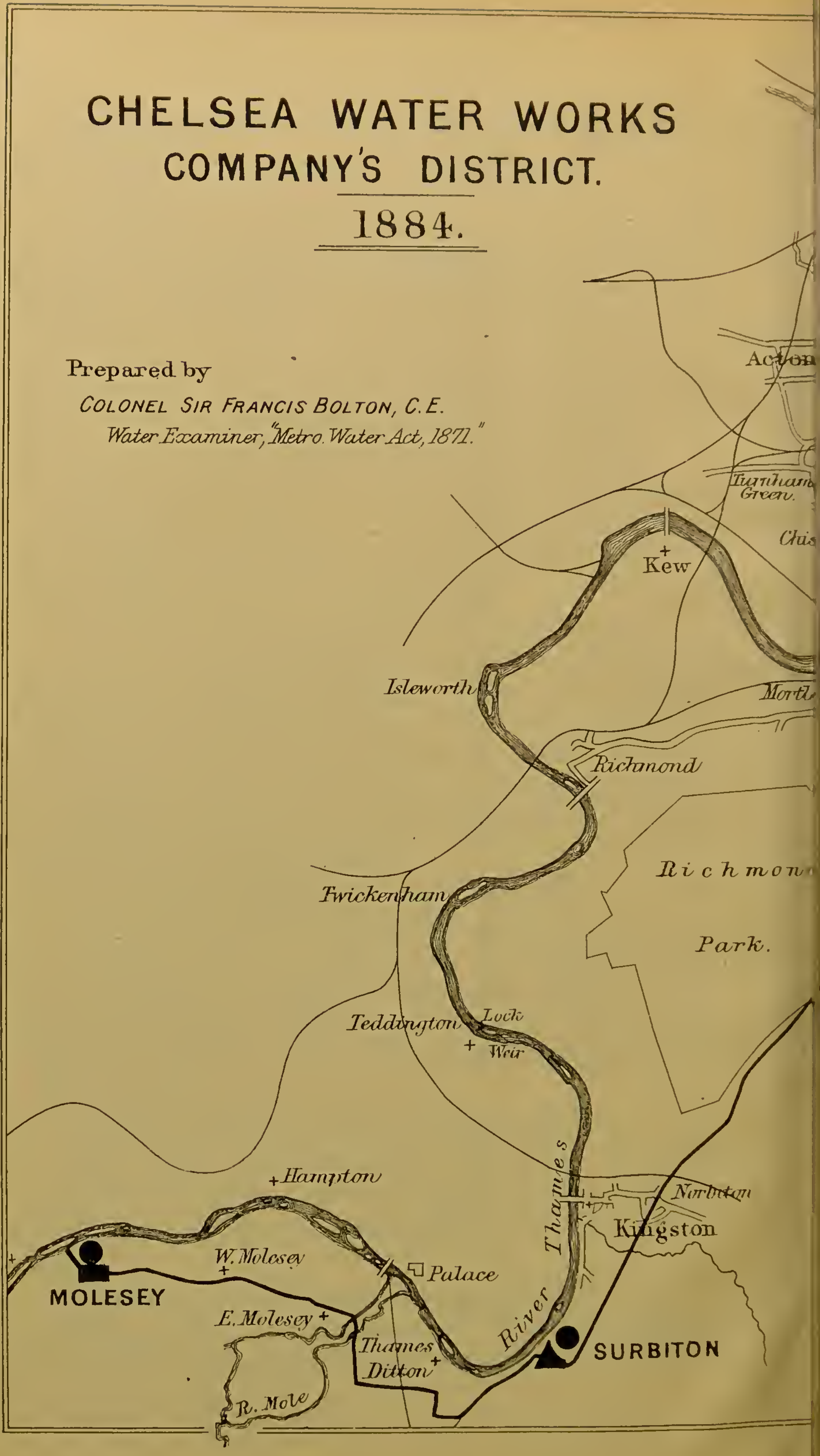
The existing engines are contained in two separate houses, and are fed with steam from 20 boilers.

A separate pair of engines of 50 horse-power formerly pumped a supply of unfiltered water for road-watering purposes. This system was abandoned in 1870, when it was found more economical to supply none but filtered water.

A smaller engine is used for drainage purposes.

These works also comprise a length of river wall, hydraulic machinery for unloading and storing coal, extensive workshops, coal store, offices, workmen's cottages, &c.

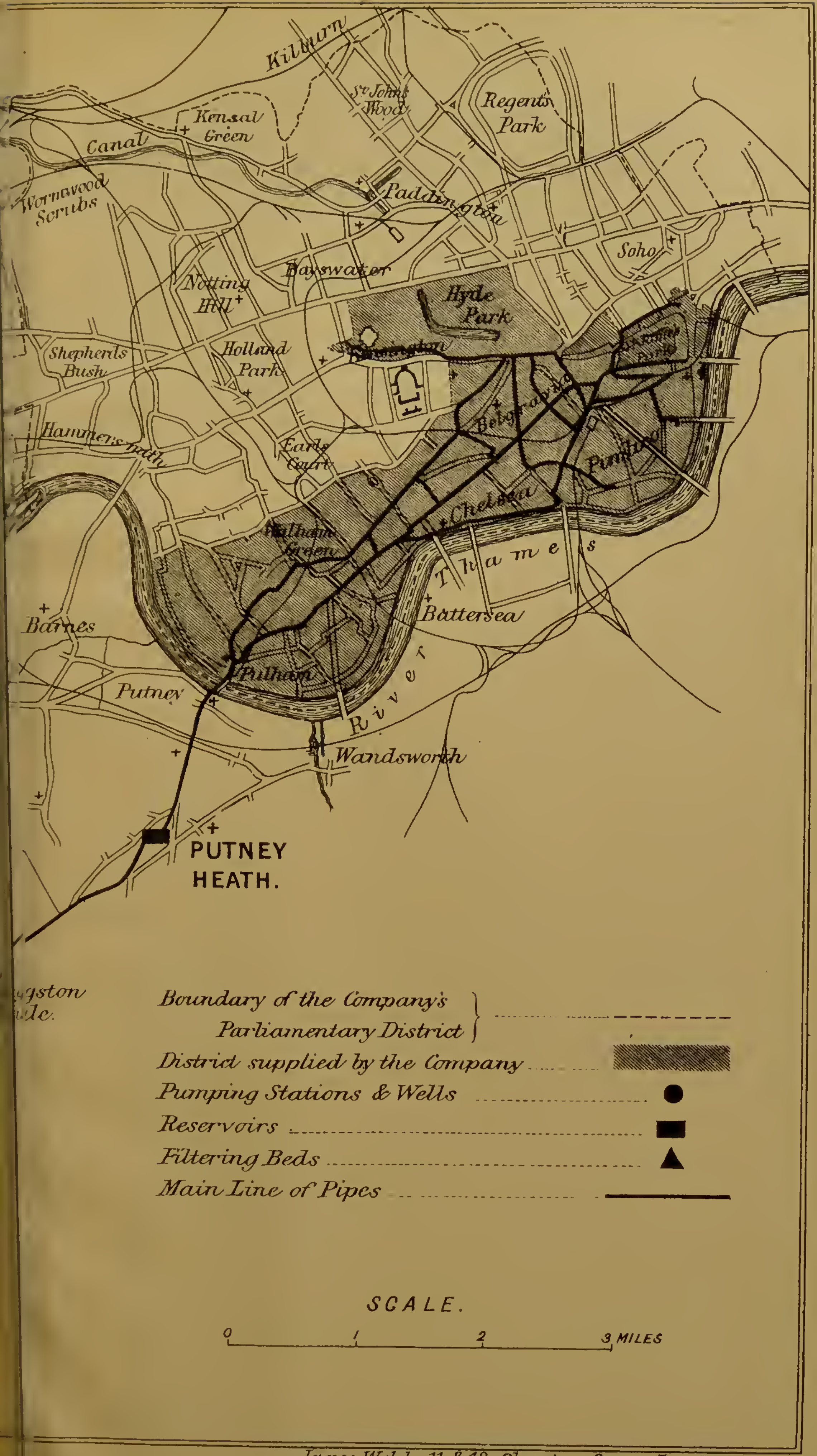
The filtered water is pumped by the engines already described up to the service reservoirs on Putney Heath, a distance of over five miles, through 3 lines of pipes, viz. two



CHELSEA WATER WORKS COMPANY'S DISTRICT.

1884.

Prepared by
COLONEL SIR FRANCIS BOLTON, C.E.
Water Examiner, "Metro. Water Act, 1871."



James Wyld, 11 & 12 Charing Cross, London.

THE LAMBETH WATER WORKS COMPANY.

TABLE No. 7A.—Statement shewing the Capital authorised, raised and expended at the end of each year, together with the Income, Expenditure on Maintenance and Management, Profit on Trading, Interest paid, Net Profit, Dividends paid, &c., for each year, during a period of ten years.

Prepared (in connection with the International Health Exhibition of 1884) for the Diagrams of COLONEL SIR FRANCIS BOLTON, C.E., *Water Examiner under the "Metropolis Water Act, 1871," by* ALFRED LASS, F.C.A.

or Year ending	CAPITAL AUTHORISED, RAISED AND EXPENDED (at the end of each Year)												INCOME.				
	Share and Loan Capital authorised.	SHARE AND LOAN CAPITAL RAISED AND PREMIUMS RECEIVED.						Balance of Authorised Capital remaining to be raised.	CAPITAL EXPENDED AND EMPLOYED.				Gross Water Rents.	Written off as Losses, for Empty Houses, Houses Cut off, and Bad Debts.	Net Water Rents.	Miscellaneous Receipts, Rent of Lands, &c.	Total Income.
		Ordinary Stocks and Shares.	Preference Stock.	Bonds and Debentures.	Total Share and Loan Capital raised.	Premiums received.	Total Share and Loan Capital raised and Premiums received.		Capital expended.	Capital in Hand or Overdrawn.		Capital employed.					
										In Hand.	Overdrawn.						
31st March,	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	1,498,000	891,580	...	235,950	1,127,530	6,065	1,133,595	370,470	1,094,722	38,873	..	1,133,595	119,475 18 8	9,458 12 9	110,017 5 11	57 16 4	110,075 2 3
1875	1,498,000	953,650	...	233,350	1,187,000	6,065	1,193,065	311,000	1,171,966	21,099	...	1,193,065	123,935 0 1	9,580 18 5	114,354 1 8	60 16 9	114,414 18 5
1876	1,498,000	1,046,781	...	210,015	1,256,796	6,065	1,262,861	241,204	1,255,826	7,035	...	1,262,861	128,702 4 6	9,102 5 5	119,599 19 1	69 18 6	119,669 17 7
1877	1,450,000	1,107,987	...	195,965	1,303,952	6,065	1,310,017	146,048	1,299,212	10,805	. .	1,310,017	135,852 18 3	9,070 8 6	126,782 9 9	107 11 6	126,890 1 3
1878	1,559,500	1,108,075	...	207,165	1,315,240	6,065	1,321,305	244,260	1,325,660	...	4,355	1,325,660	141,483 1 6	9,245 16 0	132,237 5 6	112 1 0	132,349 6 6
1879	1,559,500	1,108,075	...	238,845	1,346,920	6,065	1,352,985	212,580	1,340,863	12,122	...	1,352,985	146,488 11 8	8,434 0 11	138,054 10 9	79 12 6	138,134 3 3
1880	1,572,815	1,182,860	...	214,055	1,396,915	6,065	1,402,980	175,900	1,390,874	12,106	...	1,402,980	152,899 4 0	7,477 11 2	145,421 12 10	103 8 6	145,525 1 4
1881	1,573,088	1,226,667	...	209,055	1,435,722	6,065	1,441,787	137,366	1,435,766	6,021	...	1,441,787	164,523 9 10	10,166 18 1	154,356 11 9	115 18 3	154,472 10 0
1882	1,573,634	1,286,764	...	173,955	1,460,719	6,065	1,466,784	112,915	1,471,752	...	4,968	1,471,752	174,213 13 8	9,785 4 5	164,428 9 3	164 0 5	164,592 9 8
1883	1,574,180	1,312,909	...	173,955	1,486,864	6,065	1,492,929	87,316	1,505,754	...	12,825	1,505,754	186,008 18 8	11,146 17 7	174,862 1 1	157 12 6	175,019 13 7
Total . . .	...	...	...	...	...	...	...	...	...	...	...	...	1,473,583 0 10	93,468 13 3	1,380,114 7 7	1,028 16 3	1,381,143 3 10

or Year ending,	EXPENDITURE ON MAINTENANCE.										EXPENDITURE ON MANAGEMENT.								
	Maintenance of Reservoirs, Filtering Beds, Works, and Pipes for Storing Water.	Maintenance of Mains, &c., Meters, and Works connected with Distribution, including Renewals.	Pumping and Engine Charges, including Coals.	Filtration.	Salaries of Engineer and Clerks, and Wages of Inspector and Turncocks.	Rents owing by the Company.	Thames Conservancy.	Rates and Taxes.	Compensations, Premises and Mills; Superannuations and Law Expenses connected with Maintenance.	Total Expenditure on Maintenance.	Directors.	Company's Auditors.	Secretary, Accountant and Clerks.	Superannuation	Collectors.	General Establishment Charges.	Law and Parliamentary.	Official Auditor and Water Examiner.	Total Expenditure on Management.
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.		£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	2,272 11 5	6,094 15 4	20,544 9 7	1,025 2 8	4,584 3 9	223 15 0	1,250 0 0	5,782 17 9	...	41,777 15 6	1,215 0 0	31 17 10	1,561 13 8	..	2,530 9 6	464 7 6	423 4 5	108 18 2	6,335 11 1
1875	2,038 0 1	6,103 5 1	19,156 12 3	1,002 9 0	4,687 1 11	223 15 0	1,252 0 0	5,574 15 2	...	40,037 18 6	1,210 0 0	31 15 2	1,581 6 8	...	2,724 17 11	543 8 2	371 13 8	121 7 4	6,584 8 11
1876	1,938 12 8	6,843 15 7	20,575 7 5	990 3 4	4,848 9 3	223 15 0	1,251 0 0	5,159 16 7	...	41,830 19 10	1,210 0 0	31 15 2	1,642 12 9	...	2,821 9 1	535 14 2	405 17 3	134 14 11	6,782 3 4
1877	1,526 11 3	7,514 19 6	20,750 13 8	1,072 9 0	5,106 18 4	223 15 0	1,252 0 0	7,833 4 7	...	45,280 11 4	1,822 10 0	63 15 8	1,717 15 0	...	3,069 1 11	569 5 8	1,011 7 8	138 14 5	8,392 10 4
1878	1,248 16 5	7,680 3 11	18,989 6 6	1,108 6 4	5,203 3 11	273 15 0	1,252 0 0	6,705 12 7	...	42,461 4 8	1,822 10 0	63 15 8	1,687 2 6	964 12 6	3,767 1 9	700 17 1	235 10 6	138 17 3	9,380 7 3
1879	2,019 13 4	10,414 19 11	20,294 18 4	1,075 0 11	5,397 17 0	261 5 0	2,002 0 0	7,355 3 2	...	48,820 17 8	1,837 10 0	64 6 2	1,970 12 6	934 14 2	3,333 0 7	607 18 9	589 1 9	137 3 1	9,474 7 0
1880	1,603 11 8	10,363 19 2	18,943 11 2	1,165 18 8	5,708 3 4	211 15 0	2,252 0 0	7,517 7 0	...	47,766 6 0	1,837 10 0	64 6 2	1,905 4 2	929 14 2	3,532 9 4	728 17 6	1,712 13 0	139 5 10	10,850 0 2
1881	1,752 8 2	12,367 2 4	20,951 2 11	1,253 9 5	5,739 16 2	211 5 0	2,252 0 0	7,971 9 9	...	52,498 13 9	1,845 0 0	53 16 3	1,753 0 0	1,123 7 6	3,882 6 10	770 17 3	3,790 6 2	140 15 10	13,359 9 10
1882	2,520 14 1	12,124 12 4	23,483 15 11	1,276 15 0	5,554 0 5	211 5 0	2,252 0 0	10,224 13 7	...	57,647 16 4	1,837 10 0	53 11 10	2,090 5 5	1,579 2 6	4,014 18 4	668 11 5	431 17 9	148 16 10	10,824 14 1
1883	3,614 5 0	12,376 13 10	23,751 13 5	1,374 12 6	5,533 10 11	160 15 0	2,252 0 0	10,541 18 5	...	59,605 9 1	1,848 15 0	64 14 0	2,146 15 1	1,614 11 2	4,124 16 9	688 3 2	928 8 1	157 11 6	11,573 14 9
Total, . .	20,535 4 1	91,884 7 0	207,441 11 2	11,344 6 10	52,363 5 0	2,225 0 0	17,267 0 0	74,666 18 7	...	477,727 12 8	16,486 5 0	523 13 11	18,056 7 9	7,146 2 0	33,800 12 0	6,278 0 8	9,900 0 3	1,366 5 2	93,557 6 9

For Year ending	Total Expenditure on Maintenance and Management.	Profit on Trading.	Interest Paid on Preference, and Debenture Stocks and Loans, less Interest on Deposits, &c.	Net Profit.	Dividends paid on Ordinary Shares.	Surplus.	Deficiency.	Contingency Fund.	
								Taken from	Carried to
31st March,	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
1874	48,113 6 7	61,961 15 8	10,823 6 3	51,138 9 5	50,281 11 5	856 18 0	...	2,250 7 5	...
1875	46,622 7 5	67,792 11 0	11,416 16 3	56,375 14 9	53,758 19 9	2,616 15 0	...	...	...
1876	48,613 3 2	71,056 14 5	9,413 17 11	61,642 16 6	60,041 0 5	1,601 16 1	...	...	...
1877	53,673 1 8	73,216 19 7	8,773 2 5	64,443 17 2	66,297 16 8	...	1,853 19 6	3,000 0 0	...
1878	51,841 11 11	80,507 14 7	8,848 12 2	71,659 2 5	69,273 9 11	2,385 12 6	...	...	...
1879	58,295 4 8	79,838 18 7	9,032 18 9	70,805 19 10	69,326 15 7	1,479 4 3	...	...	2,500 0 0
1880	58,616 6 2	86,908 15 2	9,113 11 0	77,795 4 2	71,053 10 2	6,741 14 0	...	. .	581 18 3
1881	65,858 3 7	88,614 6 5	8,886 10 3	79,727 16 2	79,190 10 6	537 5 8	...	...	...
1882	68,472 10 5	96,119 19 3	8,615 0 5	87,504 18 10	84,347 4 9	3,157 14 1	...	..	...
1883	71,179 3 10	103,840 9 9	7,687 6 5	96,153 3 4	90,963 14 11	5,189 8 5	...	...	...
Total, ...	571,284 19 5	809,858 4 5	92,611 1 10	717,247 2 7	694,534 14 1	24,566 8 0	1,853 19 6	5,250 7 5	3,081 18 3

To face page 163.

lines of 30 inches and one of 15 inches diameter, the lift being to an elevation of 180 feet above the engine wells.

3. *Putney Heath.* This station consists of three service reservoirs with a joint capacity of 11,000,000 gallons. One of these reservoirs, originally an open one, designed to contain the unfiltered water formerly used for road-watering, was, after the discontinuance of that system, arched over and used for the high-service supply of the district. The reservoirs are situated at an elevation of 185 feet above Ordnance datum.

From Putney Heath the water flows by gravitation through four mains, two of 24 inches diameter and two of 12 inches diameter, into the district, crossing the Thames by an aqueduct a little above Putney Bridge. This aqueduct is now being removed to give place to the new granite bridge in course of erection by the Metropolitan Board, a temporary aqueduct having been constructed alongside old Putney Bridge to carry the Company's pipes pending the construction of the new bridge, across which the pipes will be eventually laid, under the footways.

Though not one of the largest, this is one of the most important districts in London.

The total length of mains and pipes laid by this Company amounts at the present date to about 215 miles.

Further statistical details relating to this Company's Works will be found in *Statistics of Supply*, *Table No.* 8 (*ante*, facing page 38), and concerning its Capital, Income, Expenditure, and Profits, in *Table No.* 8A appended.

A map is also appended, shewing the parliamentary boundaries of the Company, the position of the principal works, and direction of the mains, the district supplied being distinguished by shading.

THE OLD LONDON BRIDGE WATERWORKS.

While these pages were in the press the following interesting article appeared in the *St. James's Gazette*, descriptive of the Old London Bridge Waterworks, which were absorbed by the New River Company, as already mentioned (p. 94, *supra*):—

With a population of some five millions seated upon its banks, it is not wonderful that the condition of the Thames should be a subject of surpassing interest and importance. The present may be regarded as not the least important epoch in its history; and the multitude of views and opinions put forward as to the best mode of freeing the river, decisively and for all time, from the deteriorating influences that now beset it are as remarkable for their variety as for the vigour with which each from its own point of view is advocated. Similar vigour, however, has never been wanting in prior discussions of the like kind; and it may be interesting at the moment to recur to an almost forgotten chapter in the river's history, the picturesque facts of which are entitled to be much more widely known than appears from some unexplained cause to be the case.

Before Myddelton, in 1608, began his important work of bringing the New River from Chadwell and Amwell to London, the water supply of the City was alike indequate and ill arranged. The citizens were not without established sources to look to: certain "conduits" and wells existed within the civic boundaries; but their service seems to have been so irregular and insufficient, that the bulk of the water for domestic requirements was still procured by the primitive method of fetching it in buckets from the river. The numerous lanes running down to its bank greatly facilitated this operation: which, however, towards the end of the sixteenth century struck an ingenious Dutch engineer, "denizen of London," as being so unworthy of the citizens that he set to work upon a scheme to remedy it. This was forty years before the drainage of the Fen district by Vermuyden had brought Dutch engineers into notice; but Master Peter Morrys was so favourably known that he was enabled in 1582 to present his scheme to the Corporation. His idea was a simple one, and by its adoption the City was in fact largely supplied with water for nearly 250 years afterwards. It consisted of a system of water-wheels, to be erected in certain of the nineteen arches of which "old" London Bridge was composed; and which, worked by the power of the tides, were to pump the river-water to a height sufficient for its subsequent distribution through pipes. This was the plan eulogized by Stow as being of "great convenience and no small profit to the City;" though, as regards the latter result, it may be believed that it served the projector and his family even better than it did his neighbours. At all events, impressed with the feasibility of the idea, the Corporation granted Morrys a lease of the first arch on the City side for a term of five-hundred years, at the rent of 10*s.* per annum; and two years afterwards the second arch was granted on similar terms. More than a hundred years passed before (in 1701) another arch was leased to a grandson of the original inventor; and at this time the proprietary rights of the concern were disposed of to one Richard Soams, a goldsmith, for the considerable sum of £36,000. The latter converted the undertaking into a company, by dividing the property into 300 shares of £500 each; and that its prosperity continued may be concluded from the fact that, in 1761, yet another arch of the bridge, the fourth, was granted to the existing proprietors.

These gradual encroachments upon the tidal way were not universally regarded with the same equanimity. On the contrary, they were the subjects of constant disputes and petitions; and, as may be imagined, the wharfingers and lightermen made bitter complaint of the dangereus eddies occasioned by the obstructions —two other archways having also been closed to give additional power to the water-works. At its best the actual water-way under the old bridge bore an absurdly small proportion to the width of the river. This was still further contracted by the immense platforms ("sterlings") built round the piers, which so dammed up the water at the return of the tide that the river above the bridge was then about five feet higher than it was below. During the ebb the water came down with a rush, and was in fact converted into so many "rapids," the shooting of which demanded considerable skill, and was never unattended with risk. Advocates for the existing state of things were not, however, wanting; and among the pleas put forward was one which bears a curious resemblance to that which has been heard in connection with the present difficulties between Isleworth and Teddington. It was "that the bridge was originally so constructed as to restrain the ebbing of the tide and preserve the navigation of the river above it; and that if the arches were widened the tide would ebb away so fast that there would be scarcely any navigation above the bridge a little after high water."

Notwithstanding the unquiet period upon which the works seem now to have entered, the proprietors were not lacking in confidence. In 1767 they presented a petition to the Committee for Letting the City lands; which—after setting forth the facts of the previous grants, and that the petitioners were even yet unable to furnish sufficient water—made application for a lease of another (the fifth) arch of the bridge, by which, and the use of their fire-engine, the company "humbly apprehended they should be enabled, not only to supply the common exigencies of their tenants, but also the extraordinary demands for water whenever the dreadful calamities of fire should require it." Strange as it may appear, the lease was granted; but only after a hot discussion, and under the express condition that, if it should be found prejudicial to the navigation of the river, the Corporation should be at liberty to revoke it. The most eminent engineers of the day (including Smeaton and Brindley) were consulted in the matter; and the result was that the first five arches of the bridge were occupied with a series of immense water-wheels; and the two central archways, which had been for some time closed, having been again thrown open, wheels were also placed in the two arches at the south end.

It would be tedious to attempt a minute description of the machinery of these extensive works. That it was remarkably good of its kind is certain enough; though it was of course variously modified during its long period of service. Smeaton himself designed an improved kind of wheel after the grant of the fifth arch; and the sight of the entire apparatus worked by a strong tide was without doubt an imposing one. The wheels were of the kind technically known as "undershot;" that is to say, the water flowed beneath them, the momentum only of the current being utilized. The axles of each series were 19 feet in length and 3 feet in diameter; their "bearings" being so arranged as to be adjustable to the proper level of the tide. Over 2,000 gallons of water were raised to a height of 120 feet every minute by the united power of the whole; and shortly before their removal it was stated before a Committee of the House of Commons that in the year 1820 the works had delivered 26,000,000 hogsheads of water for the use of the citizens. In all, ten separate sets of main-pipes were thus supplied; the Bishopsgate main by the wheels under the third and the western end of the fourth arch; Cheapside main from the wheels under the second and third arches; while the remaining wheels were connected with the Aldgate, Fleet-street, Newgate-street, and other mains adjacent. These were the most imperfectly constructed portions of the machinery; and the bridge itself sustained much damage—it was, in fact, always under repair—from the constant leakage of the numerous pipes laid across it. Its safety, and the interests of the waterworks, had been long declared to be so diametrically opposite, that the one must prove the absolute ruin of the other.

But the time was at hand when the old order of things was to give place to the new. In 1817 the proprietors, still energetic in the prosecution of their business, gave notice according to the terms of their holding that they were about to rebuild their largest water-wheel—a design, however, which was never to be carried into effect. In 1822 an Act of Parliament was passed for the entire removal of the works, and for the very necessary erection of a new bridge. The old one had stood for over six centuries, and had given shelter to the ponderous wheels beneath it for 240 years. In that period they had performed no despicable service; and, judged by the standand of the time, their work is yet entitled to the approval of posterity.

APPENDIX I.

MEMORANDUM

AS TO THE DUTIES AND POWERS OF THE LOCAL GOVERNMENT BOARD UNDER THE ENACTMENTS APPLICABLE TO THE METROPOLIS WATER SUPPLY.

This memorandum comprises a statement of the effect of certain statutory provisions which relate to the Water Supply of the Metropolis and impose duties or confer powers upon the Local Government Board.

The method adopted in the preparation of the statement has been to reproduce, as far as possible, the language of the several statutes in an abbreviated form, to include the substance of all provisions which show the nature of the incidents and consequences of the action of the Board, and to add such definitions as are necessary to indicate the scope of that action and the particular authorities and administrative areas affected by it.

The contents of the divisions and subdivisions of the text are summarised in head-notes printed in italics, and references to the Acts and sections from which the text has been compiled are in every case appended.

WATER.

(*a.*) New Sources of Supply.

Company to give Notice to Board before resorting to new Sources.

Three months before resorting to a new source of supply, a company supplying the Metropolis or any part thereof with water for domestic use must give notice to the Board.

Appointment of Inspector to report on existing and new Sources.

Within one month after receipt of the notice, the Board, if they think fit, shall appoint an inspector to report with respect to sources then specially authorised by Parliament, whether the directions of the special Act, *i.e.* every Act relating to the company, have been complied with in reference thereto, and with respect to new sources not specially authorised by Parliament, whether they are capable of supplying good and wholesome water for domestic purposes.

Board to certify Approval or Disapproval of Sources, &c.

The Board, within 21 days after the receipt of the inspector's report, must send to the company with respect to any such new sources a certificate of approval or disapproval, and, with respect to any such sources then specially authorised by Parliament, a notice, stating whether in the judgment of the Board the directions of the special Act have in reference thereto been complied with.

If Board disapprove, Company not to use Sources.

After receiving a certificate of disapproval of any such new source the company must not use the source, and after receipt of notice that in the judgment of the Board the directions of the special Act with reference to any sources then specially authorised by Parliament have not been complied with, the company, before complying with those directions, must not use those sources.

(15 & 16 *Vict. c.* 84. *ss.* 5, 7, *and* 8; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part III.*)

(*b.*) Inquiries as to Quantity and Quality of Water.

On complaint as to Quantity and Quality of Water, Board may appoint a Person to inquire and report.

If complaint as to the quantity or quality of the water supplied by a company for domestic use be made to the Board by memorial signed by not less than 20 inhabitant householders paying rents for and supplied with water by the company, the Board, within one month after the receipt of the complaint, may appoint a competent person to inquire into the grounds of such complaint, and to report to them thereon.

If Complaint appears well founded, Board to give Notice to Company.

If after receipt of the report it appears to the Board that the complaint is well founded, they must give notice thereof to the company.

Company to remove Grounds of Complaint.

After the receipt of the notice the company must within a reasonable time remove the grounds of the complaint.

(15 & 16 *Vict. c.* 84. *ss.* 9, 12, *and* 13; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part III.*)

Board empowered to appoint Person to inquire into and report on Quality of Water.

The Board may at any time appoint a competent person to inquire into and report on the quality of the water furnished by a company, notwithstanding that no complaint has been made by inhabitant householders.

The provisions of the *Metropolis Water Act*, 1852, are to apply as if the person were appointed under Section 9 of that Act, and as if any matter reported to the Board as requiring alteration on the part of the company had been the subject of a complaint by householders.

(34 & 35 *Vict. c.* 113. *s.* 35; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part III.*)

Appointment, Duties, and Remuneration of Water Examiner.

A water examiner, being a competent and impartial person, is to be from time to time appointed and removable by the Board.

The water examiner from time to time, in such manner as the Board direct, must examine the water supplied by any company to ascertain whether or not the company have complied with Section 4 of the *Metropolis Water Act*, 1852, *i.e.*, as to effectual filtration, and must report to the Board the results of his examinations.

The Board must send a copy of every report to the company to which it relates.

The companies must pay the water examiner such remuneration and in such proportions as the Board appoint.

(34 & 35 *Vict. c.* 113. *s.* 36; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part. III.*)

(*c.*) Constant Supply.

Appeal to Board on Requisition or Proposal for Constant Supply.

When application has been made to a company requiring it to provide a constant supply, or when a company has given notice to a metropolitan authority of a proposal to give a constant supply in any district, and the company or the authority object to the requisition or proposal, the company or authority within one month after the making of the application or service of the notice may present a memorial to the Board, setting forth the objections to the requisition or proposal.

The Board, as soon as conveniently may be after the receipt of the memorial, must take it into consideration, and may institute an inquiry in relation thereto, and may hear the company and authority desiring to be heard, and may make such order in reference thereto and as to the costs thereof and incident to the same as to them seems just.

(34 & 35 *Vict. c.* 113. *s.* 9; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part III.*)

Board empowered to require Constant Supply.

The Board may require a constant supply to be provided in any district by the company within whose limits the district is situate, upon complaint and in case it appears to the Board after due inquiry,—

That the metropolitan authority refuse to make or unreasonably delay making application for the constant supply; or

That by reason of the insufficiency of the existing supply, or the unwholesomeness of the water in consequence of its being improperly stored, the health of the inhabitants is or is likely to be prejudicially affected.

(34 & 35 *Vict. c.* 113. *s.* 11; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part III.*)

Board empowered to extend Time for Works.

Where a constant supply is required and the company is unable to execute all the necessary works within the time prescribed by the Act, the Board may extend the time for the giving of the supply generally, or may extend the time and direct the supply to be given at different times in succession to the several parts of the district in such manner as may be found most convenient.

Application by the company for the extension of time must be made within one month after notice requiring a constant supply has been served upon them.

(34 & 35 *Vict. c.* 113. *s.* 13; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V.*, *Part III.*)

Provision on order of Board for Supply in Courts, &c.

If it appears to the Board, on the report of the nuisance authority, that a constant supply cannot be well and effectually provided for a group or number of dwelling-houses in a court or passage, or otherwise in contiguity with or in close neighbourhood to one another, except by means of a stand-pipe or other apparatus placed outside the dwelling-houses, the Board may order the group or number of dwelling-houses to be so supplied, and they must serve their order on the company within whose limits the houses are situate.

If there is more than one owner of the dwelling-houses, the expense of providing the stand-pipe or other apparatus is to be borne by the respective owners in such proportions as the Board direct.

The Board may at any time abrogate, wholly or in part, the order, or may originally grant it only for a limited period.

(34 & 35 *Vict. c.* 113. *s.* 14; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V.*, *Part III.*)

(*d.*) Regulations.

Company at request of Board may repeal or alter Regulations.

A company, if it thinks fit, or if requested by the Board, may repeal or alter any of the regulations made for preventing the waste or misuse, undue consumption or contamination of water, or may make new regulations.

Board may appoint Person to report and may make Regulations.

In case a company, on being requested by the metropolitan authority, or by any 10 consumers of the water supplied by the company, to repeal or alter any regulations in force or to make new regulations, refuses to do so, the Board may appoint a competent and impartial person of engineering knowledge and experience to report to them as to such regulations as may be necessary, or as to the expediency of altering or repealing such regulations, or of making new regulations in conformity with the request of the authority or consumers, and on his report the Board may make such regulations, repeal, or alterations as they think fit.

Penalties for Offences against Regulations.

Regulations may impose penalties for offences not exceeding in respect of any offence the sum of 5*l.*

Regulations to be confirmed by Board.

No regulation, repeal, or alteration of a regulation made by a company is to be of any force unless and until it is submitted to and confirmed by the Board.

Inquiry by Board as to Regulations.

They may institute such inquiry as they think fit, and at the inquiry must hear the metropolitan authority and the company, if desiring to be heard. The Board, if they think fit, or if requested, must nominate and have present at the inquiry to advise and assist them a competent and impartial waterworks engineer.

The Board may, after the inquiry, confirm or disallow any regulation, repeal, or alteration in whole or in part, or may confirm it with a modification or alteration.

No regulation, repeal, or alteration is to be made by the Board except after a like inquiry and hearing, with the like advice and assistance.

Notice to be given before Confirmation.

No regulation, repeal, or alteration is to be confirmed or made by the Board unless notice has been given by the company or by such person as the Board direct in the *London Gazette*, and in two daily morning newspapers circulated within the limits of the *Metropolis Water Act*, 1871, one month at least before the inquiry.

Copies to be deposited for Inspection.

A copy of the regulation, repeal, or alteration is to be sent by the company or person one month at least before the inquiry to the office of the metropolitan authority, and for one month it is to be kept open during office hours at the offices of the authority and of the company to the inspection of all persons without fee or reward, and a copy of it, or of any part of it, is to be furnished to every person who applies, on payment of 6*d.* for every 100 words in the copy.

(34 & 35 *Vict. c.* 113. *ss.* 18, 19, 20, *and* 22; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V. Part III.*)

(*e.*) Prescribed Fittings.

Notice by Company to Owner or Occupier to supply Premises with Fittings.

Where a company is required or has proposed to provide a constant supply, the company, after the expiration of one month after the publication in the *London Gazette* of a copy of the notice requiring or proposing the constant supply, unless a memorial or application has been presented or made to the Board objecting to the constant supply or seeking an extension of time, and if any such memorial or application has been presented or made, then, at such time after the determination of the Board in relation to the memorial or application as they approve and order, may cause to be served on the owner or occupier of any premises a notice requiring them to supply the premises with the prescribed fittings.

Appointment by Board of Person to enter Premises for inspection or repair of Fittings.

Where a company is required or has proposed to provide a constant supply, a person appointed by the Board may at all reasonable times enter any premises to inspect and examine them with a view to ascertain whether there are in or about them the prescribed fittings, or, where authorised, to provide or repair the fittings.

(34 & 35 *Vict. c.* 113. *ss.* 27 *and* 30; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part III.*)

(*f.*) Accounts and Audit.

Annual Accounts in prescribed Form to be forwarded to Board.

Every company, on or before the 31st of July in every year, must fill up and forward to the Board a statement of account made up to the end of its financial year then last passed, in such form and containing such particulars as may from time to time be prescribed by the Board.

A company making default is liable to a penalty not exceeding 10*l.* for each day during which the default continues.

Appointment and Remuneration of Auditor.

An auditor of the accounts of the companies, being a competent and impartial person, is to be from time to time appointed and removable by the Board.

The companies must pay the auditor such remuneration and in such proportions as the Board appoint.

(34 & 35 *Vict. c.* 113. *ss.* 37 *and* 38 ; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part III.*)

(*g.*) Penalties.

Penalties on Companies for Non-compliance with Statutory Provisions.

A company violating, refusing, or neglecting to comply with any of the provisions in Sections 1–14 of the *Metropolis Water Act*, 1852, is to forfeit to Her Majesty the sum of 200*l.*, and the further sum of 100*l.* for every month during which it continues to violate or to refuse or neglect to comply with the same after receiving notice from the Board to discontinue such violation, refusal or neglect.

(15 & 16 *Vict. c.* 84, *s.* 16 ; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part III.*)

A company violating, refusing, or neglecting to comply with any of the provisions in Sections 1–15 of the *Metropolis Water Act*, 1871, is liable to a penalty not exceeding 200*l.*, and to a further penalty not exceeding 100*l.* for every month during which the violation, refusal, or neglect continues after the company has received notice from the Board to discontinue such violation, refusal, or neglect.

(34 & 35 *Vict. c.* 113. *s.* 16; 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part III.*)

(*h.*) Definitions.

Meaning of "*Metropolitan Authority*," "*Nuisance Authority*," *and* "*Metropolis.*"

"Metropolitan authority" means, as regards the City of London and its liberties, the mayor, aldermen, and commons of the City of London, and, as regards the Metropolis, except the City of London and its liberties, the Metropolitan Board of Works.

(34 & 35 *Vict. c.* 113, *s.* 2, *Sch. A.* 38 & 39 *Vict. c.* 55. *s.* 343, *Sch. V., Part III.*)

"Nuisance authority" means, as regards the City of London and its liberties, the Commissioners of Sewers, and, as regards the Metropolis (*exclusive of the City of London and its liberties*), the vestry or district board under the *Metropolis Management Act*, 1855.

(23 & 24 *Vict. c.* 77, *ss.* 2 *and* 6; 29 & 30 *Vict. c.* 90. *s.* 15; 34 & 35 *Vict. c.* 113. *s.* 14.)

"Metropolis" means the Metropolis as defined by the *Metropolis Management Act*, 1855.

(34 & 35 *Vict. c.* 113. *s.* 3.)

Limits of Metropolis Water Acts.

The limits within which the provisions of the *Metropolis Water Act*, 1852, and the *Metropolis Water Act*, 1871, are in force include the Metropolis.

(34 & 35 *Vict. c.* 113. *ss.* 2 *and* 4.)

RATES OF SUPPLY.

I.—KENT WATERWORKS COMPANY.

The following charges are authorised to be made by the Kent Waterworks Company (*vide* Kent Waterworks Act, 1864) :—

28. The company shall, at the request of the owner or occupier of any house or part of a house in any street in which from time to time any pipe of the company is laid, or of any person who, under the provisions of this Act, is entitled to demand a supply of water for domestic purposes, furnish to him a sufficient supply of water for domestic purposes, at rates not exceeding the following (that is to say),

Where the yearly value of the house supplied does not exceed seven pounds, eight shillings :
Where it exceeds seven pounds and does not exceed eight pounds, nine shillings and sixpence :
Where it exceeds eight pounds and does not exceed nine pounds, ten shillings and sixpence :
Where it exceeds nine pounds and does not exceed ten pounds, twelve shillings :
Where it exceeds ten pounds and does not exceed eleven pounds, thirteen shillings :
Where it exceeds eleven pounds and does not exceed twelve pounds, fourteen shillings :
Where it exceeds twelve pounds and does not exceed thirteen pounds, fifteen shillings and sixpence :
Where it exceeds thirteen pounds and does not exceed fourteen pounds, sixteen shillings and sixpence :
Where it exceeds fourteen pounds and does not exceed fifteen pounds, eighteen shillings :
Where it exceeds fifteen pounds and does not exceed sixteen pounds, nineteen shillings :
Where it exceeds sixteen pounds and does not exceed seventeen pounds, one pound :

Where it exceeds seventeen pounds and does not exceed eighteen pounds, one pound one shilling and sixpence:

Where it exceeds eighteen pounds and does not exceed nineteen pounds, one pound two shillings and sixpence:

Where it exceeds nineteen pounds and does not exceed twenty pounds, one pound and four shillings:

Where it exceeds twenty pounds and does not exceed twenty-five pounds, one pound and eight shillings:

Where it exceeds twenty-five pounds and does not exceed thirty pounds, one pound and eleven shillings:

Where it exceeds thirty pounds and does not exceed thirty-five pounds, one pound and fifteen shillings:

Where it exceeds thirty-five pounds and does not exceed forty pounds, two pounds:

Where it exceeds forty pounds and does not exceed forty-five pounds, two pounds and five shillings:

Where it exceeds forty-five pounds and does not exceed fifty pounds, two pounds and ten shillings:

Where it exceeds fifty pounds and does not exceed sixty pounds, two pounds and fifteen shillings:

Where it exceeds sixty pounds and does not exceed seventy pounds, three pounds and three shillings:

Where it exceeds seventy pounds and does not exceed eighty pounds, three pounds and ten shillings:

Where it exceeds eighty pounds and does not exceed ninety five pounds, three pounds and sixteen shillings:

Where it exceeds ninety-five pounds, at a rate not exceeding four pounds *per centum per annum* on the yearly value.

29. A supply of water for domestic purposes includes a supply of water for one water-closet, but not a supply of water for more than one water-closet, or for any bath, and does not include a supply of water for cattle or for horses, or for washing carriages, if the horses or carriages are kept for hire, or by common carriers, or are the property of a dealer, or for steam engines, or for railway purposes, or for warming or ventilating purposes, or for working any machine or apparatus, or for any trade, manufacture, or business, whatsoever, or for watering gardens by means of any tap, tube, pipe, or other like apparatus, or for fountains, or for flushing sewers or drains, or for public baths, or for any ornamental purpose whatever.

30. The company may charge for every year, in respect of every water-closet more than one, and every bath, in any dwelling

house, in addition to the ordinary yearly rates, any rates not exceeding the following yearly rates (that is to say),

Where the yearly value of the dwelling house does not exceed nine pounds, five shillings for every water-closet more than one, and six shillings for every bath:

Where the yearly value of the dwelling house exceeds nine pounds and does not exceed twenty pounds, six shillings for one water-closet beyond the first, and eight shillings for one bath, and five shillings for every additional water-closet, and six shillings for every additional bath:

Where the yearly value of the dwelling house exceeds twenty pounds and does not exceed forty pounds, seven shillings for one water-closet beyond the first, and ten shillings for one bath, and five shillings for every additional water-closet, and six shillings for every additional bath:

Where the yearly value of the dwelling house exceeds forty pounds and does not exceed sixty pounds, eight shillings, for one watercloset beyond the first, and ten shillings for one bath, and five shillings for every additional watercloset and six shillings for every additional bath:

Where the yearly value of the dwelling house exceeds sixty pounds and does not exceed eighty pounds, eight shillings for one watercloset beyond the first, and twelve shillings for one bath, and five shillings for every additional water-closet, and six shillings for every additional bath:

Where the yearly value of the dwelling house exceeds eighty pounds, ten shillings for one water-closet beyond the first, and twelve shillings for one bath, and five shillings for every additional water-closet, and six shillings for every additional bath.

II.—NEW RIVER WATERWORKS COMPANY.

The following charges are authorised to be made by the New River Waterworks Company (*vide* New River Company's Act, 1852):—

XXXV. That the company shall, at the request of the owner or occupier of any house or part of a house in any street within their limits in which any pipe of the company shall be laid, or of any person who, under the provisions of this Act or any Act incorporated therewith, shall be entitled to demand a supply of water for domestic purposes, furnish to such owner or occupier or other person a sufficient supply of water for domestic purposes at the rates hereinafter specified (that is to say),

For water supplied to any dwelling house:

Where the annual value of the dwelling-house shall not exceed two hundred pounds, at a rate *per centum per annum* on such value not exceeding four pounds:

Where such annual value shall exceed two hundred pounds, at a rate *per centum per annum* on such value not exceeding three pounds:

If there be a water-closet or water-closets, or fixed bath or baths, or any high service in such dwelling-house or place, then, in addition to the rates above specified, the following rates shall be payable (that is to say),

Where the annual value of such house shall exceed thirty pounds but shall not exceed fifty pounds, a rate not exceeding four shillings *per annum* for each single water-closet, fixed bath, or high service, and a further sum of two shillings for each additional water-closet, fixed bath, or high service:

Where such annual value shall exceed fifty pounds but shall not exceed one hundred pounds, a rate not exceeding six shillings *per annum* for each single water-closet, fixed bath, or high service, and a further sum of three shillings for each additional water-closet, fixed bath, or high service:

Where such annual value shall exceed one hundred pounds, but shall not exceed two hundred pounds, a rate not exceeding eight shillings for each single water-closet, fixed bath, or high service, and a further sum of four shillings for each additional water-closet, fixed bath, or high service:

Where such annual value shall exceed two hundred pounds but shall not exceed three hundred pounds, a rate not exceeding ten shillings for each single water-closet, fixed bath, or high service, and a further sum of five shillings for each additional water-closet, fixed bath, or high service:

And where such annual value shall exceed three hundred pounds, a rate not exceeding twelve shillings for each single water-closet, fixed bath, or high service, and a further sum of six shillings for each additional water-closet, fixed bath, or high service.

XXXVI. That the expression "high service" in this Act shall mean and be considered as being a delivery of water at an elevation more than ten feet above the ground floor of such dwelling-house or other place supplied.

XXXVII. Provided, That with respect to all service which shall be given at an elevation of more than one hundred and sixty feet above *Trinity* high-water mark it shall be lawful for the company to charge, in addition to the rates hereinbefore authorised, a further sum not exceeding one pound *per centum per annum* on the annual value of such dwelling-houses respectively.

XXXVIII. That a supply of water for domestic purposes shall not include a supply of water for steam engines or railway purposes, or for warming or ventilating purposes, or for working any machine or apparatus, or for baths, horses, cattle, or for washing carriages, or for gardens, fountains, or ornamental purposes, or for flushing sewers or drains, or for any trade or manufacture or business requiring an extra supply of water.

XXXIX. That the company may, notwithstanding the provisions of this Act or any Act incorporated therewith, take an increased rate or charge by agreement with the person or body requiring a supply of water, and notwithstanding the same may exceed the rates or charges herein specified.

XL. That the company may supply any person or body within their limits with water, to be used within such limits for other than domestic purposes, at such rates and upon such terms and conditions as shall be agreed upon between the company and the person or body requiring such supply.

XLI. That the company shall, at the request of any consumer of water for purposes other than the purposes for or in respect of which the rates or charges are hereinbefore provided or limited, or at their own instance, afford a supply of water by means of a meter or other instrument or mode for measuring and ascertaining the quantity of water so supplied, and may charge for such supply not exceeding the following rates *per* one thousand gallons (that is to say),

When the quarterly consumption of water shall not exceed fifty thousand gallons, sevenpence halfpenny :

When exceeding fifty thousand gallons and not exceeding one hundred thousand gallons, sevenpence :

When exceeding one hundred thousand gallons and not exceeding two hundred thousand gallons, sixpence halfpenny :

When exceeding two hundred thousand gallons, sixpence :
And a further rate not exceeding twenty-five pounds *per centum* in respect of water so supplied at an elevation of more than sixty feet above *Trinity* high-water mark.

III.—East London Waterworks Company.

The following charges are authorised to be made by the East London Water Company (*vide* East London Waterworks Act, 1853) :—

LXXII. That a supply of water for domestic purposes shall not include a supply of water for steam engines or railway purposes, or for warming or ventilating purposes, or for working any machine or apparatus, or for horses or cattle, or for washing carriages, or for gardens, fountains, or ornamental purposes, or for flushing sewers or drains, or for any trade or manufacture or business requiring an extra supply of water, or, as regards any house of which the annual value does not exceed thirty pounds, a supply of water for baths.

LXXIII. That the expression "ordinary service" in this Act means water delivered at an elevation not higher than twenty feet above the level of the pavement adjoining or nearest to the dwelling-house or other place supplied ; and the expression "high service" in this Act means water delivered at an elevation exceeding twenty feet above the level of the pavement adjoining or nearest to the dwelling-house or other place supplied.

LXXIV. That the company shall, at the request of the owner or occupier of any house or of any part of a house occupied as a separate tenement in any street within their limits in which any main or service pipe of the company is or shall be laid, or of any person who under this Act shall be entitled to demand a supply of water for domestic purposes, furnish to such person, by means of communication pipes and other necessary and proper apparatus to be provided, laid down, and maintained at the cost of such person, a sufficient supply of water for his domestic purposes at a rate *per centum per annum* on the annual value of the house not exceeding five pounds.

LXXV. Where the annual value exceeds thirty pounds, an additional rate not exceeding four shillings *per annum* for every single watercloset and for every single fixed bath :

Where the annual value exceeds fifty pounds, but does not exceed one hundred pounds, an additional rate not exceeding six shillings *per annum* for every single watercloset and for every single fixed bath :

And where the annual value exceeds one hundred pounds, an additional rate not exceeding eight shillings for every single watercloset and for every single fixed bath.

LXXVI. And with respect to high service the company may charge, in addition to the foregoing rates respectively, such further rates as they from time to time fix, not respectively exceeding twenty-five *per centum per annum* upon the foregoing several rates respectively.

LXXVII. That the company shall not be bound to supply more than one dwelling-house or other building by means of any one communication pipe.

LXXVIII. That the company may supply any person or body within their limits with water to be used within such limits for other than domestic purposes, at the rate and upon the terms and conditions agreed upon between the company and the person or body requiring such supply.

LXXIX. That the company may, at their own instance, and shall at the request of any owner or occupier of any premises situate in or adjoining any street in which any main or service pipe of the company is or shall be laid, and who requires a supply of water by measure for purposes other than the purposes in respect of which rates are by this Act provided or limited, and by means of communication pipes and other necessary and proper apparatus, to be provided, laid, and maintained at the cost of the person requiring such supply, afford a supply of water by meter or other fit and sufficient instrument or mode for measuring and ascertaining the quantity of water so supplied, and may charge for such supply not exceeding the following rates for every one thousand gallons (to wit),

In respect of ordinary service :

When the quarterly consumption of water does not exceed fifty thousand gallons, ninepence :

When exceeding fifty thousand gallons and not exceeding one hundred thousand gallons, eightpence :

When exceeding one hundred thousand gallons and not exceeding two hundred thousand gallons, sevenpence :

When exceeding two hundred thousand gallons, sixpence :

And in respect of high service :

An additional rate not exceeding twenty-five *per centum* upon those several rates for ordinary service :

Provided always that the company shall not be required so to supply water in any less quantity than twenty five thousand gallons in any quarter of a year.

LXXX. Provided always, that, notwithstanding any of the provisions of this Act, the company may take an increased rate or charge by agreement with any person or body requiring a supply of water, and notwithstanding the same exceed the rates or charges in this Act specified.

IV.—SOUTHWARK AND VAUXHALL WATERWORKS COMPANY.

The following charges are authorised to be made by the Southwark and Vauxhall Waterworks Company (*vide* Southwark and Vauxhall Water Act, 1852):—

LIII. That the company shall, at the request of the owner or occupier of any house or part of a house occupied as a separate tenement in any street within their limits in which any main or service pipe of the company shall be laid, or of any other person who under this Act shall be entitled to demand a supply of water for domestic purposes, furnish to such person, by means of communication pipes and other necessary and proper apparatus, to be provided, laid down, and maintained at the cost of such person, a sufficient supply of water for his domestic purposes, at a rate *per centum per annum* on the aunual value of the house not exceeding five pounds:

If there be a water-closet or water-closets, or fixed bath or baths, or any high service in such dwelling-house or place, then, in addition to the rates above specified, the following rate shall be payable (that is to say),

Where the annual value of such house shall exceed thirty pounds but shall not exceed fifty pounds, a rate not exceeding four shillings *per annum* for each single water-closet, fixed bath, or high service, and a further sum of two shillings for each additional water-closet, fixed bath, or high service:

Where such annual value shall exceed fifty pounds but shall not exceed one hundred pounds, a rate not exceeding six shillings *per annum* for each single water-closet, fixed bath, or high service, and a further sum of three shillings for each additional water-closet, fixed bath, or high service:

Where such annual value shall exceed one hundred pounds but shall not exceed two hundred pounds, a rate not exceeding eight shillings for each single water-closet, fixed bath, or high service, and a further sum of four shillings for each additional water-closet, fixed bath, or high service :

Where such annual value shall exceed two hundred pounds but shall not exceed three hundred pounds, a rate not exceeding ten shillings for each single water-closet, fixed bath, or high service, and a further sum of five shillings for each additional water-closet, fixed bath, or high service :

And where such annual value shall exceed three hundred pounds, a rate not exceeding twelve shillings for each single water-closet, fixed bath, or high service, and a further sum of six shillings for each additional water-closet, fixed bath, or high service.

LIV. That the expression "high service" in this Act shall mean and be considered as being a delivery of water at an elevation more then ten feet above the footway or pavement in front of the dwelling house or other place supplied.

LV. That a supply of water for domestic purposes shall not include a supply of water for steam engines or railway purposes, or for warming or ventilating purposes, or for working any machine or apparatus, or for baths, horses, cattle, or for washing carriages, or for gardens, fountains, or ornamental purposes, or for flushing sewers or drains, or for any trade or manufacture or business requiring an extra supply of water.

LVI. That the company may supply any person or body within their limits with water to be used within such limits for other than domestic purposes, at such rate and upon such terms and conditions as shall be agreed upon between the company and the person or body requiring such supply.

LVII. That the company may at their own instance, and shall at the request of any owner or occupier of any premises situate in or adjoining any street in which any main or service pipe of the company shall be laid, and who requires a supply of water by measure for purposes other than the purposes in respect of which rates are by this Act provided or limited, and by means of communication pipes and other necessary and proper apparatus to be provided, laid, and maintained at the cost of the person requiring such supply, afford a supply of water by meter, or other fit and sufficient instrument or mode for measuring and ascertaining the quantity of water so supplied, and may charge for such supply not exceeding the following rates for each one thousand gallons (that is to say),

In respect of ordinary service :

When the quarterly consumption of water does not exceed fifty thousand gallons, ninepence :

When exceeding fifty thousand gallons and not exceeding one hundred thousand gallons, eightpence :

When exceeding one hundred thousand gallons and not exceeding two hundred thousand gallons, sevenpence :

When exceeding two hundred thousand gallons sixpence :

And in respect of high service :

An additional rate not exceeding twenty-five *per centum* upon the several rates last hereinbefore specified and authorised for ordinary service :

Provided that the company shall not be required so to supply water in any less quantity than twenty-five thousand gallons in any quarter of a year.

V.—WEST MIDDLESEX WATERWORKS COMPANY.

The following charges are authorised to be made by the West Middlesex Waterworks Company (*vide* West Middlesex Waterworks Act, 1852) :—

XXXIX. That the company shall, at the request of the owner or occupier of any house in any street within the limits of this Act in which any pipe of the company shall be laid, or of any person who, under the provisions of this Act or any Act incorporated therewith, shall be entitled to demand a supply of water for domestic purposes, furnish to such owner or occupier or other person a sufficient supply of water for their domestic purposes at the rates hereinafter specified (that is to say),

Where the annual value of the dwelling house or other place supplied shall not exceed two hundred pounds, at a rate *per centum per annum* on such value not exceeding four pounds; and where such annual value shall exceed two hundred pounds, at a rate *per centum per annum* on such value not exceeding three pounds :

If there be a watercloset or waterclosets, or fixed bath or baths, or any high service, in such dwelling house or place, then, in addition to the rates above specified, the following rates shall be payable (that is to say),

Where the annual value of such house shall exceed thirty pounds but shall not exceed fifty pounds, a rate not exceeding four shillings *per annum* for each single watercloset, fixed bath, or high service, and a further sum of two shillings for each additional watercloset, fixed bath, or high service:

Where such annual value shall exceed fifty pounds but shall not exceed one hundred pounds, a rate not exceeding six shillings *per annum* for each single watercloset, fixed bath, or high service, and a further sum of three shillings for each additional watercloset, fixed bath, or high service:

Where such annual value shall exceed one hundred pounds but shall not exceed two hundred pounds, a rate not exceeding eight shillings for each single watercloset, fixed bath, or high service, and a further sum of four shillings for each additional watercloset, fixed bath or high service:

Where such annual value shall exceed two hundred pounds but shall not exceed three hundred pounds, a rate not exceeding ten shillings for each single watercloset, fixed bath, or high service, and a further sum of five shillings for each additional watercloset, fixed bath, or high service:

And where such annual value shall exceed three hundred pounds, a rate not exceeding twelve shillings for each single watercloset, fixed bath, or high service, and a further sum of six shillings for each additional watercloset, fixed bath, or high service.

XL. That the expression "high service" in this Act shall mean and be considered as being a delivery of water at an elevation more than ten feet above the footway or pavement in front of the dwelling-house or other place so supplied.

XLI. Provided, that with respect to all service which shall be given to any dwelling-house at an elevation of more than two hundred feet above *Trinity* high-water mark, it shall be lawful for the company to charge, in addition to the rates hereinbefore authorised, a further sum not exceeding one pound *per centum per annum* on the annual value of such dwelling-house.

XLII. That a supply of water for domestic purposes shall not include a supply of water for steam engines or railway purposes, or for warming or ventilating purposes, or for working any machine or apparatus, or for baths, horses, cattle, or for washing carriages, or for gardens, fountains, or ornamental purposes, or for flushing sewers or drains, or for any trade or manufacture or business requiring an extra supply of water.

XLIII. That the company may at their own instance, and shall at the request of any owner or occupier of any premises situate in or adjoining any street in which any main or service pipe of the company shall be laid, and who requires a supply of water by measure for purposes other than the purposes in respect of which rates are by this Act provided or limited, and by means of communication pipes and other necessary and proper apparatus to be provided, laid, and maintained at the cost of the person requiring such supply, afford a supply of water by meter, or other fit and sufficient instrument or mode for measuring and ascertaining the quantity of water so supplied, and may charge for such supply not exceeding the following rates for each one thousand gallons (that is to say),

In respect of ordinary service :

When the quarterly consumption of water does not exceed fifty thousand gallons, ninepence :

When exceeding fifty thousand gallons and not exceeding one hundred thousand gallons, eightpence :

When exceeding one hundred thousand gallons and not exceeding two hundred thousand gallons, sevenpence :

When exceeding two hundred thousand gallons, sixpence :

And in respect of high service :

An additional rate not exceeding twenty-five *per centum* upon the several rates last hereinbefore specified and authorised for ordinary service :

Provided that the company shall not be required so to supply water in any less quantity than twenty-five thousand gallons in any quarter of a year.

XLIV. That it shall be lawful for the company to supply any person or body within the limits of this Act with water, to be used within the limits aforesaid, for other than domestic purposes, at such rate and upon such terms and conditions as shall be agreed upon between the company and the person or body desirous of having such supply of water.

VI.—GRAND JUNCTION WATERWORKS COMPANY.

The following charges are authorised to be made by the Grand Junction Waterworks Company (*vide* Grand Junction Waterworks Act, 1852) :—

XLVI. That the company shall, at the request of the owner or occupier of any house in any street within the limits of this Act in which any pipe of the company shall be laid, or of any person who, under the provisions of this Act or any Act incorporated therewith, shall be entitled to demand a supply of water for domestic purposes, furnish to such owner or occupier or other person a sufficient supply of water for their domestic purposes at the rates hereinafter specified (that is to say),

Where the annual value of the dwelling-house or other place supplied shall not exceed two hundred pounds, at a rate *per centum* per annum on such value not exceeding four pounds; and where such annual value shall exceed two hundred pounds, at a rate *per centum per annum* on such value not exceeding, three pounds.

If there be a watercloset or waterclosets, or fixed bath or baths, or any high service in such dwelling-house or place, then, in addition to the rates above specified, the following rates shall be payable (that is to say),

Where the annual value of such house shall exceed thirty pounds but shall not exceed fifty pounds, a rate not exceeding four shillings per annum for each single watercloset, fixed bath, or high service, and a further sum of two shillings for each additional watercloset, fixed bath, or high service:

Where such annual value shall exceed fifty pounds but shall not exceed one hundred pounds, a rate not exceeding six shillings per annum for each single watercloset, fixed bath, or high service; and a further sum of three shillings for each additional watercloset, fixed bath, or high service:

Where such annual value shall exceed one hundred pounds but shall not exceed two hundred pounds, a rate not exceeding eight shillings for each single watercloset, fixed bath, or high service; and a further sum of four shillings for each additional watercloset, fixed bath, or high service:

Where such annual value shall exceed two hundred pounds but shall not exceed three hundred pounds, a rate not exceeding ten shillings for each single watercloset, fixed bath, or high service; and a further sum of five shillings for each additional watercloset, fixed bath, or high service:

And where such annual value shall exceed three hundred pounds, a rate not exceeding twelve shillings for each single watercloset, fixed bath, or high service; and a further sum of six shillings for each additional watercloset, fixed bath, or high service.

XLVII. That the expression "high service" in this Act shall mean and be considered as being a delivery of water at an elevation more than ten feet above the footway or pavement in front of the dwelling house or other place supplied.

XLVIII. That a supply of water for domestic purposes shall not include a supply of water for steam engines, or railway purposes, or for warming or ventilating purposes, or for working any machine or apparatus, or for baths, horses, cattle, or for washing carriages, or for gardens, fountains, or ornamental purposes, or for flushing sewers or drains, or for any trade or manufacture or business requiring an extra supply of water.

XLIX. That the company may supply any person or body within their limits with water to be used within such limits for other than domestic purposes, at such rate and upon such terms and conditions as shall be agreed upon between the company and the person or body requiring such supply.

L. That the company may, at their own instance, and shall, at the request of any owner or occupier of any premises situate in or adjoining any street in which any main or service pipe of the company shall be laid, and who requires a supply of water by measure, for purposes other than the purposes in respect of which rates are by this Act provided or limited, and by means of communication pipes and other necessary and proper apparatus to be provided, laid, and maintained at the cost of the person requiring such supply, afford a supply of water by meter or other fit and sufficient instrument or mode for measuring and ascertaining the quantity of water so supplied, and may charge for such supply not exceeding the following rates for each one thousand gallons (that is to say),

In respect of ordinary service:

When the quarterly consumption of water does not exceed fifty thousand gallons, ninepence:

When exceeding fifty thousand gallons, and not exceeding one hundred thousand gallons, eightpence:

When exceeding one hundred thousand gallons, and not exceeding two hundred thousand gallons, sevenpence :

When exceeding two hundred thousand gallons, sixpence :

And in respect of high service :

An additional rate not exceeding twenty-five *per centum* upon the several rates last hereinbefore specified and authorised for ordinary service :

Provided that the company shall not be required so to supply water in any less quantity than twenty-five thousand gallons in any quarter of a year.

VII.—LAMBETH WATERWORKS COMPANY.

The following charges are authorised to be made by the Lambeth Waterworks Company (*vide* Lambeth Waterworks Act, 1848):—

XXXVII. And be it enacted, that the company shall, at the request of the owner or occupier of any house or part of a house in any street within the limits of this Act in which any pipe of the company shall be laid, or of any person who, under the provisions of this Act or any Act incorporated therewith, shall be entitled to demand a supply of water for domestic purposes, furnish to such owner or occupier or other person a sufficient supply of water for their domestic uses at the rates hereinafter specified (that is to say),

If there be no water-closet in the dwelling-house or part of the dwelling house to be supplied with water, at the following rates :

Where the annual value of such house shall not exceed twenty pounds, at a rate *per centum per annum* not exceeding seven pounds ten shillings :

Where the annual value of such house shall exceed twenty pounds but shall not exceed forty pounds, at a rate per *centum per annum* not exceeding seven pounds :

Where such annual value shall exceed forty pounds, but shall not exceed sixty pounds, at a rate *per centum per annum* not exceeding six pounds ten shillings :

Where such annual value shall exceed sixty pounds but shall not exceed eighty pounds, at a rate *per centum per annum* not exceeding six pounds :

Where such annual value shall exceed eighty pounds but shall not exceed one hundred pounds, at a rate *per centum, per annum* not exceeding five pounds ten shillings:

And where such annual value shall exceed one hundred pounds, at a rate *per centum per annum* not exceeding five pounds:

If there be a water-closet or water-closets in such dwelling house, then, in addition to the rates above specified, the following rates shall be payable (that is to say),

Where the annual value of such dwelling-house shall exceed twenty pounds but shall not exceed forty pounds, a rate not exceeding ten shillings *per annum* for one water-closet, and a further sum of five shillings for each additional water-closet:

Where the annual value of such dwelling-house shall exceed forty pounds but shall not exceed sixty pounds, a rate not exceeding twelve shillings *per annnm* for one water-closet, and a further sum of six shillings for each additional water-closet:

Where the annual value of such dwelling-house shall exceed sixty pounds but shall not exceed one hundred pounds, a rate not exceeding fifteen shillings for one water-closet, and a further sum of seven shillings and sixpence for each additional water-closet:

And where such annual value shall exceed one hundred pounds, at a rate not exceeding twenty shillings for one water-closet, and a further sum of ten shillings for each additional water-closet.

XXXVIII. And be it enacted, that it shall be lawful for the company to supply any person or body within the limits of this Act with water to be used within the limits aforesaid for other than domestic purposes at such rent and upon such terms and conditions as shall be agreed upon between the company and the person or body desirous of having such supply of water.

XXXIX. And be it enacted, that a supply of water for domestic pnrposes shall not include a supply of water for baths, horses, cattle, or for washing carriages, or for any trade or business whatsoever.

VIII.—CHELSEA WATERWORKS COMPANY.

The following charges are authorised to be made by the Chelsea Water Company (*vide* Chelsea Waterworks Act, 1852):—

LX. That the company shall, at the request of the owner or occupier of any house in any street within the limits of this Act in which any pipe of the company shall be laid, or of any person who, under the provisions of this Act or any Act incorporated therewith, shall be entitled to demand a supply of water for domestic purposes, furnish to such owner or occupier or other person a sufficient supply of water for their domestic purposes, at the rates hereinafter specified (that is to say),

Where the annual value of the dwelling-house or other place supplied shall not exceed two hundred pounds, at a rate *per centum per annum* on such value not exceeding four pounds:

And where such annual value shall exceed two hundred pounds, at a rate *per centum per annum* on such value not exceeding three pounds:

If there be a watercloset or waterclosets, or fixed bath or baths, or any high service, in such dwelling-house or place, then, in addition to the rates above specified, the following rates shall be payable (that is to say),

Where the annual value of such house shall exceed thirty pounds but shall not exceed fifty pounds, a rate not exceeding four shillings *per annum* for each single watercloset, fixed bath or high service, and a further sum of two shillings for each additional watercloset, fixed bath, or high service:

Where such annual value shall exceed fifty pounds but shall not exceed one hundred pounds, a rate not exceeding six shillings *per annum* for each single watercloset, fixed bath, or high service, and a further sum of three shillings for each additional watercloset, fixed bath, or high service:

Where such annual value shall exceed one hundred pounds but shall not exceed two hundred pounds, a rate not exceeding eight shillings for each single watercloset, fixed bath, or high service, and a further sum of four shillings for each additional watercloset, fixed bath, or high service:

Where such annual value shall exceed two hundred pounds but shall not exceed three hundred pounds, a rate not exceeding ten shillings for each single watercloset, fixed bath, or high service, and a further sum of five shillings for each additional watercloset, fixed bath, or high service :

And where such annual value shall exceed three hundred pounds, a rate not exceeding twelve shillings for each single watercloset, fixed bath, or high service, and a further sum of six shillings for each additional watercloset, fixed bath, or high service.

LXI. That the expression "high service" in this Act shall mean and be considered as being a delivery of water at an elevation more than ten feet above the pavement in front of the dwelling-house or other place supplied.

LXII. That with respect to the several rates above specified a supply of water for domestic purposes shall not include a supply of water for steam engines or railway puposes, or for warming or ventilating purposes, or for working any machine or apparatus, or for public baths, horses, cattle, or for washing carriages, or for gardens, fountains, or ornamental purposes, or for flushing sewers or drains, or for any trade or manufacture or business requiring an extra supply of water.

LXIII. That it shall be lawful for the company to supply any person or body within the limits of this Act with water, to be used within the limits aforesaid for other than domestic purposes, at such rate and upon such terms and conditions as shall be agreed upon between the company and the person or body desirous of having such supply of water.

STATUTORY POWERS AS TO DIVIDENDS.

The following is a copy of a paper which was submitted to the Select Committee appointed to report on the London Water Supply, 1880.

With respect to the powers of the Water Companies as to dividends, the following questions arise :

1. What is the maximum rate of dividend authorised?
2. What is the right of the shareholders to back dividends?

The answers to these questions depend upon the general and special legislation applicable to each case.

I. GENERAL LEGISLATION.

The general legislation on the subject is chiefly contained in the following provisions :—

Section 75 of the Waterworks Clauses Act, 1847, enacts that "The profits of the undertaking to be divided amongst the undertakers in any year, shall not exceed the prescribed rate, or where no rate is prescribed, they shall not exceed the rate of ten pounds in the hundred by the year, on the paid-up capital in the undertaking, which in such case shall be deemed the prescribed rate, unless a larger dividend be at any time necessary to make up the deficiency of any previous dividend which shall have fallen short of the said yearly rate."

Sections 76–78 provide for the formation, out of surplus profits, of a reserved fund; and by Section 79 it is enacted that "If in any year the profits of the undertaking divisible amongst the undertakers shall not amount to the prescribed rate, such a sum may be taken *from the Reserved Fund* as, with the actual divisible profits of such year, will enable the undertakers to make a dividend of the amount aforesaid, and so from time to time as often as the occasion shall require."

Section 121 of the Companies Clauses Act, 1845, prohibits the making of dividends, so as to reduce capital. The provision is incorporated in the special Acts of most of the Water Companies, but need not be further noticed for the purposes of this memorandum.

By Sections 80-83 of the Waterworks Clauses Act, 1847, provisions are made for obliging the undertakers, when they have paid their maximum dividends, and have a reserve fund intact, to reduce the price of water. "Prescribed" in the above enactments means "prescribed for that purpose in the special Act."

It is open to question whether the Waterworks Clauses Act, 1847, can, in the absence of special provision, be effectually incorporated with a special Act of a water company which does not authorise any new works; inasmuch as Section 1 of the Waterworks Clauses Act, 1847, enacts "That this Act shall extend only to such Waterworks as shall be authorised by any Act of Parliament hereafter to be passed, which shall declare that this Act shall be incorporated therewith. And all the clauses of this Act, save so far as they shall be expressly varied or excepted by any such Act, shall apply to the undertaking authorised thereby, so far as the same shall be applicable to such undertaking, and shall, with the clauses of every other Act which shall be incorporated therewith, form part of such Act, and be construed therewith as forming one Act."

II. SPECIAL LEGISLATION.*

The following are the chief provisions in the Special Legislation affecting the several companies in relation to the points referred to.

No. 1.—The Kent Company.

The special Act of 1862 (which is the chief Act) fixed the share capital at £420,000, all of which was to be ordinary, and it repealed the provisions of the previous special Acts with respect to the raising of capital. It did not incorporate the Waterworks Clauses Act, or make any regulations as to dividends.

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* *Note.*—In the original paper the companies followed each other in a different order. They have been transposed here so as to preserve the numerical arrangement adopted throughout this book, but without alteration of matter.

The special Act of 1864, which amalgamated the Kent and the North Kent Companies, incorporated the Waterworks Clauses Act, unless where expressly varied or excepted by the special Act (Section 2), and whilst giving power to raise fresh share capital to the extent of £180,000, made no express provision as to dividends. It did not extend the application of those Acts.

The special Act of 1877 incorporated in itself the previous Acts, and also the provisions of the Companies Clauses Act, 1845, "with respect to the making of dividends." It gave powers to create new shares or stock amounting to £160,000, to "form part of the capital," and to be entitled to a dividend with shares or stock of the same class or description; but by Section 26 the new shares, if ordinary, were only to bear 7 per cent., and, if preference, only 6 per cent. It is also provided by Section 27 that: "In case in any half year the net revenues of the company applicable to dividend shall be insufficient to pay the full amount of the maximum rate to which each class of ordinary stock or shares in the capital of the company is entitled, a rateable deduction shall be made in the dividend of each class."

No. 2.—The New River Company.

The special Act of 1852, which is now the chief Act, fixed the Company's capital at £1,519,958, with power to raise further sums, amounting to £400,000, by bond. This Act by Section 3 incorporates the Waterworks Clauses Act, with certain exceptions not affecting profits or dividends, but it provides "that the clauses with respect to the construction of works for the accommodation of lands adjoining the water-works, and with respect to mines, shall not apply to any works constructed on lands acquired by the Company previously to the passing of the Act." The Act authorised the construction of certain new works. No rate of dividend is expressly prescribed by it, or by the previous special Acts.

The special Acts of 1854 authorised the construction of certain works, and the raising of money by bond. Certain sections of the Waterworks Clauses Act, but not those relating to dividends, are incorporated, and it is declared that they shall extend only to the several works by these Acts authorised to be made.

By Section 5 of the special Act of 1857 the Company were empowered to convert their bond debt into a permanent debenture stock, bearing a fixed dividend not exceeding 5 per cent. The

Act contains no other provision as to dividend, and does not incorporate the sections of the Waterworks Clauses Act as to dividends.

The special Act of 1866, by Sections 3 and 4, empowered the company to issue new shares of the nominal value of £100 each, to the amount of £500,000; and by Section 10 the proprietors of such shares were to be entitled to dividend *pari passu* with the proprietors of original shares. The Act does not incorporate the Waterworks Clauses Act.

The special Act of 1879 further authorised the issue of debenture stock to the amount of £500,000 (to be known as "Debenture Stock B," that of 1857 being "Debenture Stock A"), to bear a fixed dividend not exceeding 4 per cent. This Act does not incorporate the Waterworks Clauses Act.

No. 3.—The East London Company.

The special Acts of 1807 and 1808 do not appear to contain any provision as to dividend, except that they provide that it shall be in proportion to the amount subscribed by each proprietor. The special Act of 1853 (which is the chief Act) incorporates the Waterworks Clauses Act, 1847, and it provides that "for the purposes of this Act the expression 'the undertaking' in the Waterworks Clauses Act, 1847, means the water-works and works connected therewith by this Act, authorised to be constructed *and maintained* respectively." (*See* also Sect. 7.) It fixes the capital at £675,000 of general stock, which might be afterwards extended £975,000. In the case of new shares having a guaranteed or preferential dividend, the rate of dividend is not to exceed 5 per cent. (Sect. 22.)

There were two special Acts in 1867. By the first, additional, works and capital (£260,000) were authorised. The Act however, does not incorporate the provisions of the Waterworks Clauses Act, 1847, with respect to dividends, and it does not contain any express provisions relating thereto. The second Act also authorises additional works and capital (£160,000). It incorporates the Waterworks Clauses Act, 1847, as regards dividends.

No. 4.—The Southwark and Vauxhall Company.

The special Act of 1852 repealed the previous Acts but continued the company, and incorporated the Waterworks

Clauses Act, 1847, except certain provisions not relating to dividends, and enacted that it should be held to apply to the company, and to the undertaking and works thereby authorised, and also, except as regards mines, notwithstanding any words of restriction contained in the Act, to the water-works, credits, and effects thereby vested in the company; and that the expression, "the undertaking," used in the Waterworks Clauses Act, 1847, shall mean not only the works authorised by the Act of 1852, but also the works by that Act vested in the company. The then authorised share capital was £400,000. The Act further authorised the issue of new shares to the amount of £180,000, provided that the amount of dividend to be guaranteed to any such shares should not exceed 7 per cent.

The special Act of 1855 (Section 11) declares that the share capital of the company shall be £900,000, and prescribes, with reference to the Waterworks Clauses Act, 1847, a dividend of 10 per cent. on £700,000, and of 7½ per cent. on the residue of the capital. Section 19 declares that the share capital created under the Act shall be part of the general capital of the company, and subject to its privileges, liabilities, and incidents.

The special Act of 1864 authorised a further issue of new shares to the amount of £300,000, to be part of the general capital of the company (Sections 4 and 5). The shareholders to be entitled to take proportionate privileges, and the shares to be subject to the like restrictions and incidents as if they were part of the original capital.

The special Act of 1867 authorised the issue of new shares to the like amount of £300,000, to be part of the general capital of the company, as in the preceding Act.

The special Act of 1872 authorised the issue of new shares to the amount of £400,000, to form part of the general capital in the same way as in the two preceding Acts.

No. 5.—The West Middlesex Company.

The special Act of 1806, which incorporated the company, states that the subscribers "shall be entitled to and receive the entire and net distribution of an equal proportionate part" of the profits, according to their contributions; and the special Act of 1810 applied this provision to the holders of shares issued under its authority. A similar provision occurs in the special Act of 1813.

The special Act of 1852, which is the chief Act, incorporates by Section 3 the Waterworks Clauses Act, 1847, without expressly extending its application, and fixes the capital at £506,300, divided into 8300 shares of £61 each (Section 6). It does not contain any express provision as to dividends.

The special Act of 1860 authorises the company to raise further capital to the extent of £180,000, either on mortgage or by the issue of new shares, preferential or otherwise, provided that if in any year the profits were not sufficient for the full amount of the preferential dividend for that year, the deficiency should not be made good out of the profits of a subsequent year, or out of any other funds. The new capital was to be part of the general capital.

The special Act of 1866 incorporates the Waterworks Clauses Act of 1847, but has no reference to capital.

The special Act of 1869 does not incorporate the Waterworks Clauses Act; it authorises the issue of new shares, which may be either ordinary or preferential, to the amount of £300,000, which is to form part of the general capital of the company. Section 7 empowers the company to issue debenture stock, to which the company may attach "such fixed and perpetual dividend as they think fit."

No. 6.—The Grand Junction Company.

The first special Act after 1847 is that of 1852. It incorporates the Waterworks Clauses Act, 1847, without extending its application. The Act, however, authorises fresh works. The Act authorises £100,000 additional share capital, the existing share capital being £331,000.

The special Act of 1855 does not incorporate the Waterworks Clauses Act, but by Section 6 enacts that (with reference to the Waterworks Clauses Act, 1847, with respect to the amount of profits to be received by the undertakers when the waterworks are carried on for their benefit) "The prescribed rate of profit shall be as follows (that is to say), as regards the sum of £546,000 (the amount which, immediately before the passing of this Act, the company were authorised to raise), £10 in the £100 by the year, and as regards the residue of their capital, £7 10*s.* in the £100 by the year." Under Section 5 the total share capital was to be £700,000.

The special Act of 1868 authorises the creation of new shares to the amount of £300,000 to be part of the "general capital." The shares might be ordinary or preferential, and the shareholders were to be entitled to the like proportionate privileges, and be subject to the like restrictions and incidents as if the shares were part of the original capital. It does not incorporate the Waterworks Clauses Act.

The special Act of 1878 incorporates the Waterworks Clauses Acts, and authorises the creation of new shares or stock to the amount of £300,000, to be on the same footing as the "existing capital;" but by Section 16 so much of it as was ordinary capital was only to bear 7 per cent., whilst the preference shares were limited to 6 per cent.

Section 17 provides, that if in any year the net revenue of the company applicable to dividends is insufficient to pay the full amount of the prescribed rate of dividend on each class of ordinary stock or shares, the revenue shall be applied, in the first place, in payment of dividend on all the ordinary paid-up capital up to 7 per cent., and next of a further dividend up to 10*s.* per cent. on the ordinary paid-up capital, created under previous Acts, and the balance in payment of dividend upon ordinary paid-up capital entitled to a higher rate than 7½ per cent.

No. 7.—The Lambeth Company.

The principal special Act (that of 1848) repeals the former Acts, and incorporates the Waterworks Clauses Act, 1847, except where the same shall be inconsistent with, or repugnant to, any of the provisions of the Act, "and it is to be held to apply to the company thereby incorporated, and to the water-works, lands, credits and effects, authorised to be made by and vested in the company." It provides for the creation of £200,000 new share capital, and there was an existing capital of £143,800. There is no special provision in the Act as to the rate of dividend.

The special Act of 1856 authorises further share capital of £406,200. It incorporates the sections of the Waterworks Clauses Act, 1847, with respect to dividends, but it provides that the prescribed rate of dividend on the new capital shall not exceed 7½ per cent.

The special Act of 1869, by Section 6, authorises new share capital of £500,000, either preference or ordinary, and Section 8 directs that the new capital shall be part of the general capital of the company. Section 17 enacts that "The Directors, without the direction or sanction of a general meeting, from time to time may declare and pay, in the interval between any two ordinary annual meetings, a half year's dividend, payable out of the profits of the company, to the shareholders; but the directors shall not make any dividend whereby the capital would be reduced." This Act does not incorporate the Waterworks Clauses Act, 1847, nor expressly prescribe a rate of dividend.

The special Act of 1871, which authorises new works, incorporates the Waterworks Clauses Act, so far as applicable to the purposes, and not inconsistent with the provisions of the special Act. It is not, however, an Act having any direct bearing on capital or profits.

No. 8.—The Chelsea Company.

The Chelsea Waterworks Act of 1852, which is the principal of the company's special Acts, and which regulates the organisation of the company as regards its capital and stock, by Section 13 incorporates the Waterworks Clauses Act, 1847, except certain specified provisions which have no reference to dividends. The existing capital was £300,000, and the Act authorises a further sum of £270,000.

The same section also provides that "the expression 'the undertaking,' used in the Waterworks Clauses Act, 1847, shall mean not only the water-works and the works connected therewith by this Act authorised to be constructed, but also the water-works and other works by this Act vested in the company," being the existing works (*see* sec. 5).

The Chelsea Waterworks Act of 1864, which confers fresh powers of raising capital (£285,000), does not expressly incorporate the Waterworks Clauses Act, 1847, or expressly except it.

The Chelsea Waterworks Act of 1875, which is also an Act authorising the raising of new capital—viz., £160,000 in addition to the ordinary share capital—by Section 2 incorporates the provisions of the Waterworks Clauses Act, 1847, with respect to the amount of profit to be received by the undertakers.

The following express provision with regard to dividends is contained in Section 24 of the Act of 1852:—"The proprietor of any share in the company shall not be entitled to any further or greater dividends than in respect of the sums which are under this Act to be deemed to have been, or which may for the time being have been paid up on such shares."

The Chelsea Acts contain no express provisions prescribing the amount of dividend; but, as already stated, the Acts of 1852 and 1875 incorporate the sections relating to dividends of the Waterworks Clauses Act, 1847.

The Act of 1864, which authorised fresh capital, does not incorporate those sections, but it does not except them; and Section 13 directs that the money raised under the Act shall be applied to any of the purposes of the undertaking.

REGULATIONS UNDER THE "METROPOLIS WATER ACT, 1871."

At the Council Chamber, Whitehall,
The 10th day of August, 1872.

Present:—The Right Hon. Chichester P. Fortescue, M.P.

WHEREAS it is provided by the Metropolis Water Act, 1871 [section 17], that every Company subject to the provisions of that Act shall, within six months after the passing of the said Act, make Regulations for the purposes for which Regulations may be made under the authority of section 26 of the Metropolis Water Act, 1852, and that the provisions of that section shall apply also to the preventing of undue consumption or contamination of water:

And whereas by the said Metropolis Water Act, 1871 [section 22], it is further provided that no such Regulation shall be of any force or effect unless and until the same be submitted to and confirmed by the Board of Trade, who may institute such inquiry in relation thereto as they shall think fit, and who, at such inquiry, shall hear the Metropolitan Authority and the Company, if desiring to be heard, and the said Board shall, if they think fit, or if requested, nominate and have present at such inquiry, to advise and assist them, a competent and impartial waterworks engineer:

And whereas it is by the said last-mentioned Act also provided, that no such Regulation shall be confirmed by the Board of Trade, unless notice in that behalf shall have been given by the Company to which the same relates, or by such person as the Board of Trade direct, in the London Gazette, and in two daily morning newspapers circulated within the limits of the said Act, one month at least before the inquiry, and that one month at least before any such inquiry is held, a copy of the Regulations in question shall be sent by such Company, or person, to the office of the Metropolitan Authority, and the same shall for one month be kept open during office hours at the respective offices of the Metropolitan Authority and of the said Company, to the inspection of all persons without fee or reward :

And whereas the Metropolitan Water Companies and the Tottenham Local Board made regulations, in accordance with the provisions of the above-named Act, and submitted the same to the Board of Trade for confirmation, and duly advertised and deposited the same with the Metropolitan Authorities :

And whereas the Metropolitan Board of Works and the Corporation of the City of London, being Metropolitan Authorities under the said last-mentioned Act, submitted objections to the said regulations, and it was deemed expedient that an inquiry should be held in relation thereto :

And whereas by the Board of Trade Inquiries Act, 1872, it is provided that wherever in any Act of Parliament it is directed that an inquiry shall be held or instituted by the Board of Trade, the same shall be deemed to have been duly held or instituted, if conducted by any person or persons duly authorised in that behalf by the President of the said Board, by writing under his hand or under the hand of one of the secretaries of the said Board :

And whereas the Board of Trade, under the powers conferred upon them as aforesaid, appointed the Right Honourable Lord Methuen, Henry Whatley Tyler, Esquire, late Captain Royal Engineers, and Robert Rawlinson, Esquire, C.E., C.B., to hold an inquiry in relation to the regulations so submitted to them by the Companies, and by the Tottenham Local Board :

And whereas the said inquiry has been held, and the said Metropolitan Authorities and the Companies and the Local Board have been heard at the inquiry :

And whereas, as the result of such inquiry, it has appeared expedient to the Board of Trade to allow such and so many of the said Regulations as are contained in the Schedule hereto annexed, with such modifications and alterations as are shown in the said Schedule :

NOW, THEREFORE, the Board of Trade do hereby confirm the said last-named Regulations so modified and altered as aforesaid.

(Signed) C. P. FORTESCUE.

[SCHEDULE.

SCHEDULE REFERRED TO IN THE ABOVE MINUTE

REGULATIONS MADE UNDER THE "METROPOLIS WATER ACT, 1871."

1. *Place of communication-pipe.*—No "communication-pipe" for the conveyance of water from the waterworks of the Company into any premises shall hereafter be laid until after the point or place at which such "communication-pipe" is proposed to be brought into such premises shall have had the approval of the Company.

2. *Weight of lead-pipes.*—No lead-pipe shall hereafter be laid or fixed in or about any premises for the conveyance of or in connection with the water supplied by the Company (except when and as otherwise authorised by these regulations, or by the Company), unless the same shall be of equal thickness throughout, and of at least the weight following, that is to say :—

Internal Diameter of Pipe in Inches.	Weight of Pipe in lbs. per Lineal Yard.
3/8-inch diameter.	5 lbs. per lineal yard.
1/2 " "	6 " "
5/8 " "	7 1/2 " "
3/4 " "	9 " "
1 " "	12 " "
1 1/4 " "	16 " "

3. *Interior pipes.*—Every pipe hereafter laid or fixed in the interior of any dwelling-house for the conveyance of, or in connection with, the water of the Company, must, unless with the consent of the Company, if in contact with the ground, be of lead, but may otherwise be of lead, copper, or wrought iron, at the option of the consumer.

4. *Not more than one communication-pipe to each house.*—No house shall, unless with the permission of the Company in writing, be hereafter fitted with more than one "communication-pipe."

5. *Every house, with certain exceptions, to have its own communication-pipe.*—Every house supplied with water by the Company (except in cases of stand pipes) shall have its own separate

"communication-pipe." Provided that, as far as is consistent with the special Acts of the Company, in the case of a group or block of houses, the water-rates of which are paid by one owner, the said owner may, at his option, have one sufficient "communication-pipe" for such group or block.

6. *No house to have connection with fittings of adjoining house.*—No house supplied with water by the Company shall have any connection with the pipes or other fittings of any other premises, except in the case of groups or blocks of houses, referred to in the preceding Regulation.

7. *Connection to be by ferrule or stop-cock.*—The connection of every "communication-pipe" with any pipe of the Company shall hereafter be made by means of a sound and suitable brass screwed ferrule or stop-cock with union, and such ferrule or stop-cock shall be so made as to have a clear area of waterway equal to that of a half-inch pipe. The connection of every "communication-pipe" with the pipes of the Company shall be made by the Company's workmen, and the Company shall be paid in advance the reasonable costs and charges of and incident to the making of such connection.

8. *Material and joints of external pipes.*—Every "communication-pipe" and every pipe external to the house and through the external walls thereof, hereafter respectively laid or fixed, in connection with the water of the Company shall be of lead, and every joint thereof shall be of the kind called a "plumbing" or "wiped" joint.

9. *No pipe to be laid through drains, &c.*—No pipe shall be used for the conveyance of, or in connection with, water supplied by the Company, which is laid or fixed through, in, or into any drain, ashpit, sink, or manure-hole, or through, in, or into any place where the water conveyed through such pipe may be liable to become fouled, except where such drain, ashpit, sink, or manure-hole, or other such place, shall be in the unavoidable course of such pipe, and then in every such case such pipe shall be passed through an exterior cast-iron pipe or jacket of sufficient length and strength, and of such construction as to afford due protection to the water-pipe.

10. *Depth of pipes under ground.*—Every pipe hereafter laid for the conveyance of, or in connection with, water supplied by the Company, shall, when laid in open ground, be laid at least two feet six inches below the surface, and shall in every exposed situation be properly protected against the effects of frost.

11. *No connection with rain-water receptacle.*—No pipe for the conveyance of, or in connection with, water supplied by the Company, shall communicate with any cistern, butt, or other receptacle used or intended to be used for rain-water.

12. *Stop-volve.*—Every "communication-pipe" for the conveyance of water to be supplied by the Company into any premises shall have at or near its point of entrance into such premises, and if desired by the consumer within such premises, a sound and suitable stop-valve of the screw-down kind, with an area of waterway not less than that of a half-inch pipe, and not greater than that of the "communication-pipe," the size of the valve within these limits being at the option of the consumer. If placed in the ground such "stop-valve" shall be protected by a proper cover and "guard-box."

13. *Character of cisterns and ball-taps.*—Every cistern used in connection with the water supplied by the Company shall be made and at all times maintained water-tight, and be properly covered and placed in such a position that it may be inspected and cleansed. Every such existing cistern, if not already provided with an efficient "ball-tap," and every such future cistern shall be provided with a sound and suitable "ball-tap" of the valve kind for the inlet of water.

14. *Waste pipes to be removed or converted into warning-pipes.*—No overflow or waste-pipe other than a "warning-pipe" shall be attached to any cistern supplied with water by the Company, and every such overflow or waste-pipe existing at the time when these regulations come into operation shall be removed, or at the option of the consumer shall he converted into an efficient "warning-pipe," within two calendar months next after the Company shall have given to the occupier of, or left at the premises in which such cistern is situate, a notice in writing requiring such alteration to be made.

15. *Arrangement of warning-pipes.*—Every "warning-pipe" shall be placed in such a situation as will admit of the discharge of the water from such "warning-pipe" being readily ascertained by the officers of the Company. And the position of such "warning-pipe" shall not be changed without previous notice to and approval by the Company.

16. *Buried cisterns prohibited.*—No cistern buried or excavated in the ground shall be used for the storage or reception of water supplied by the Company, unless the use of such cistern shall be allowed in writing by the Company.

17. *Butts prohibited.*—No wooden receptacle without a proper metallic lining shall be hereafter brought into use for the storage of any water supplied by the Company.

18. *Ordinary draw-tap.*—No draw-tap shall in future be fixed unless the same shall be sound and suitable and of the "screw-down" kind.

19. *Draw-taps in connection with stand-pipes.*—Every draw-tap in connection with any "stand-pipe" or other apparatus outside any dwelling-house in a court or other public place, to supply any group or number of such dwelling-houses, shall be sound and suitable and of the "waste-preventer" kind, and be protected as far as possible from injury by frost, theft, or mischief.

20. *Boilers, water-closets, and urinals to have cisterns.*—Every boiler, urinal, and water-closet, in which water supplied by the Company is used (other than water-closets in which hand flushing is employed), shall, within three months after these regulations come into operation, be served only through a cistern or service-box and without a stool-cock, and there shall be no direct communication from the pipes of the Company to any boiler, urinal, or water-closet.

21. *Water-closet apparatus.*—Every water-closet cistern or water-closet service-box hereafter fitted or fixed in which water supplied by the Company is to be used shall have an efficient waste-preventing apparatus, so constructed as not to be capable of discharging more than two gallons of water at each flush.

22. *Urinal-cistern apparatus.*—Every urinal-cistern in which water supplied by the Company is used other than public urinal-cisterns, or cisterns having attached to them a self-closing apparatus, shall have an efficient "waste-preventing" apparatus, so constructed as not to be capable of discharging more than one gallon of water at each flush.

23. *Water-closet down-pipes.*—Every "down-pipe" hereafter fixed for the discharge of water into the pan or basin of any water-closet shall have an internal diameter of not less than one inch and a quarter, and if of lead shall weigh not less than nine pounds to every lineal yard.

24. *Pipes supplying water-closet to communicate with cistern only.*—No pipe by which water is supplied by the Company to any water-closet shall communicate with any part of such water-closet, or with any apparatus connected therewith, except the service-cistern thereof.

25. *Bath to be without overflow pipe.*—No bath supplied with

water by the Company shall have any overflow waste-pipe, except it be so arranged as to act as a "warning-pipe."

26. *Bath apparatus.*—In every bath hereafter fitted or fixed the outlet shall be distinct from, and unconnected with, the inlet or inlets; and the inlet or inlets must be placed so that the orifice or orifices shall be above the highest water level of the bath. The outlet of every such bath shall be provided with a perfectly water-tight plug, valve, or cock.

27. *Alteration of fittings.*—No alteration shall be made in any fittings in connection with the supply of water by the Company without two days' previous notice in writing to the Company.

28. *Waterway of fittings.*—Except with the written consent of the consumer, no cock, ferrule, joint, union, valve, or other fitting, in the course of any "communication-pipe," shall have a waterway of less area than that of the "communication-pipe," so that the waterway from the water in the district-pipe or other supply-pipe of the Company up to and through the stop-valve prescribed by Regulation No. 12, shall not in any part be of less area than that of the "communication-pipe" itself, which pipe shall not be of less than a half-inch bore in all its course.

29. *Weight of lead pipes having open ends.*—All lead "warning-pipes" and other lead pipes of which the ends are open, so that such pipes cannot remain charged with water, may be of the following minimum weights, that is to say—

½-inch	(internal diameter)	3 lbs. per yard.
¾ ”	”	5 ”
1 ”	”	7 ”

30. *Definition of "communication-pipe."*—In these Regulations the term "communication-pipe" shall mean the pipe which extends from the district pipe or other supply pipe of the Company up to the "stop-valve" prescribed in the Regulation No. 12.

31. *Penalties.*—Every person who shall wilfully violate, refuse, or neglect to comply with, or shall wilfully do or cause to be done any act, matter, or thing, in contravention of these Regulations, or any part thereof, shall, for every such offence, be liable to a penalty in a sum not exceeding 5*l.*

32. *Authorised officer may act for company.*—Where under the foregoing Regulations any act is required or authorised to be done by the Company, the same may be done on behalf of the Company by an authorised officer or servant of the Company,

and where under such Regulations any notice is required to be given by the Company the same shall be sufficiently authenticated if it be signed by an authorised officer or servant of the Company.

33. *Existing fittings.*—All existing fittings, which shall be sound and efficient, and are not required to be removed or altered under these Regulations, shall be deemed to be prescribed fittings under the "Metropolis Water Act, 1871."

APPENDIX II.

THE INTERNATIONAL HEALTH EXHIBITION OF 1884.

DESCRIPTION OF THE WATER PAVILION.

In the month of January, 1884, H.R.H. the Prince of Wales addressed a letter to each of the eight Metropolitan Water Companies stating that, considering the great importance of the Water Supply of the Metropolis, it had been suggested that the several Companies supplying London with water should be invited to make a collective exhibit at the forthcoming International Health Exhibition, and requesting their co-operation—such exhibit to embrace all that related to the Sources of Supply, Collection, Filtration and Distribution, as well as to House Storage and fittings, Constant Supply, Economy and Waste of Water, and its use for every domestic purpose. In reply to this communication the Companies at once returned promises of their cordial support to the proposal, and a Sub-Committee was formed to carry out the designs and general arrangement of the exhibit. Colonel Sir Francis Bolton, C.E., the Water Examiner to the Metropolis, was appointed at the head of this Sub-Committee, which also comprised the Engineers of the Companies (whose names are given below under the separate description of the exhibits of each Company), and in addition the following gentlemen :—Professor F. de Chaumont, M.D., F.R.S. ; Brigade-Surgeon W. G. Don, A.M.D.; Professor E. Frankland, D.C.L., F.R.S.; S. H. Louttit, Esq., C.E.; W. H. Michael, Esq., Q.C.; Philip A. Scratchley, Esq., M.A.; Arthur Telford Simpson, Esq., M. Inst. C.E.; Thomas Stevenson, Esq., M.D.; John Taylor, Esq., M. Inst. C.E. ; Colonel C. E. Webber, R.E., C.B.

A Pavilion was specially constructed for the purpose of this Collective Exhibit, the object of which is to show the manner in which the inhabitants of London are supplied with water, and to convey to the general public as clear an idea as may be of the magnitude and importance of the Metropolitan Water Supply.

The Pavilion is an octagonal building, that shape having been adopted in order that each Company might have one side of the octagon for its exhibits.

From the interior angles of the Pavilion spring eight willow trees, the branches of which, being brought to an apex, form a kind of dome. The ground-work of the dome is covered by "Lincrusta Walton" decoration, in imitation of carved and fluted cedar, supplied by Messrs. F. Walton & Co., who claim for their Lincrusta that it has many valuable sanitary qualities, is impermeable to moisture, and thoroughly waterproof. The floor is laid with Rust's vitreous mosaic, by Messrs. S. Belham & Co., and is of a blue colour, to be in character with the rivers Thames and Lee.

The walls are hung with paintings by Mr. J. H. Hooper, showing the intakes and portions of the works of the several Companies. Isometrical plans, maps of the districts supplied, descriptions of the works, and statistical tables (specially compiled for the purposes of this Exhibition), giving, amongst other things, particulars as to quantity, and the area under constant supply, are also shown.

The walls of the Pavilion are decorated by a frieze, the work of Mrs. Wallroth, of Sunbury, painted on a silver ground, representing river-birds and plants.

In the centre of the Pavilion is a handsome fountain, lent by the Coalbrookdale Company, representing a swan and boy resting on a basin supported by water-lilies and other aqueous plants.

At each of the interior angles of the octagon are filter-beds, supported on a base of Norwegian marble (supplied by the Northern Stone and Marble Company), which illustrate the system of filtration adopted by each Company. This marble is said to be easily and cheaply worked and takes an excellent polish. In front of the filter-beds are glass tubes, mounted in nickel silver, conveying running water to the drinking fountains of each particular Company. During the continuance of the Exhibition the official analyses of the water which each Company supplies are attached to these fountains.

The filters, and the glass flowers used in the decorations of the Water Pavilion, have been furnished by Messrs. Defries & Sons. The patent washable mouldings were supplied by Messrs. Schulze & Co., the manufacturers. The general decorations of the Pavilion were carried out by Mr. Labhart. Messrs. William Woollams & Co. supplied the varnished papers for the walls of the outer corridor. The three cocoa-nut fibre mats laid down at the three entrances were lent by Messrs. Treloar & Sons. The patent india-rubber guards fixed on the stairs to prevent slipping were supplied by Messrs. A. Hutchinson & Co.

In the outer annexe, or corridor of the Pavilion, are the special exhibits of each Company, and at regular intervals there are specimens of the different large mains used in the Metropolis, varying in size from thirteen to forty-eight inches, as well as water meters and hydrants. The number of miles of mains used is painted on each specimen.

Several most interesting specimens of the old stone, wooden, and concrete pipes used in bygone days are exhibited side by side with the iron mains of modern times.

In the outer corridor, also, on the left of the main entrance to the Pavilion, is an exhibit which is unique in its way, being a case lent by the Aqueous Works and Diamond Rock-Boring Company, containing a remarkable and extensive collection of "cores" of different strata obtained in artesian and other borings by means of the diamond-drill, some of which have been brought up from considerable depths. Several artesian wells have been executed for different Water Companies by this system.

In the retiring angle south of the door is a specimen of a flexible pipe as used by the Southwark and Vauxhall

Company, and in the retiring angle to the north is a complete section shewing a large main as laid in a London street, with all the necessary cocks and appliances. There is also a complete section of a house supplied with fittings in accordance with the requirements of the Metropolis Water Act of 1871.

Mr. G. G. Adams, of Sloane Street, has lent for exhibition in the Water Pavilion a cast of his well-known statue, "The Diver."

Messrs. Merryweather & Sons have lent hose pipes, branches, firemen's equipment, &c., as used by the Water Companies, which are also exhibited in the annexe.

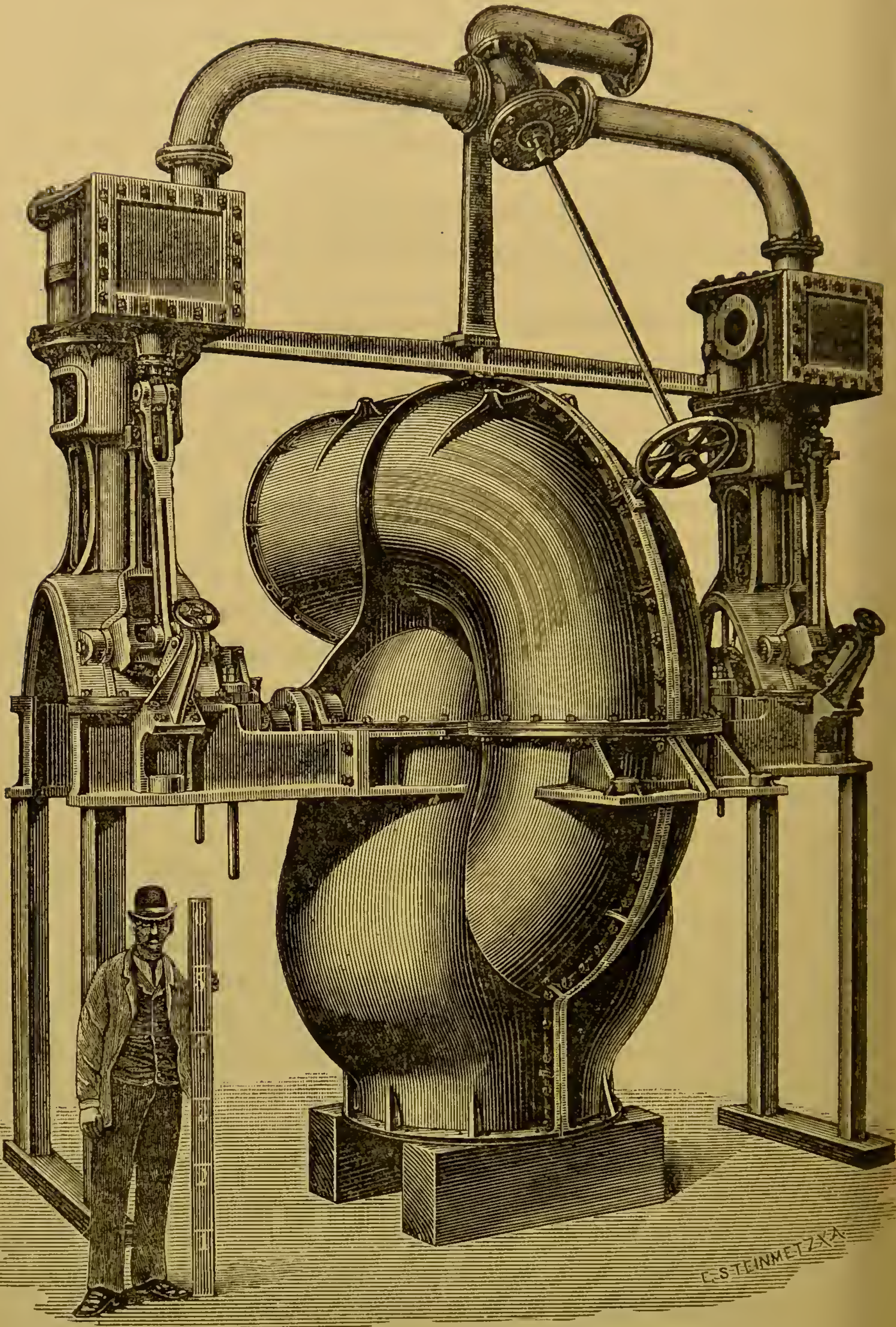
Contributions to the literature of Waterworks generally have been received from a few provincial and foreign water companies. The Chester Waterworks Company also exhibit an old wooden pipe formerly used for conveying water to that city.

The principal entrance to the Pavilion on the east side is in the form of a Gothic arch, constructed of main pipes, joints, and bends used by the Companies for the supply of water.

In the garden adjoining the Water Pavilion is a separate building containing specimens of various laboratory apparatus used in making analyses of water, and in the centre of this garden is another fountain with mermaids.

Between this fountain and the Gothic arch above-mentioned is a wrought-iron standard, thirty-six feet in height, constructed by Mr. Newman for the Duke of Westminster. This standard carries the electric light for the illumination of the garden, which has been supplied by the Electric Sun Lamp and Power Company. The crystal gas illuminations in this garden have been lent by Messrs. Defries & Sons, who have likewise constructed the glass illuminated cascades in the four canals.

In the garden adjoining the Pavilion Messrs. Simpson & Co., Engineers, of Pimlico, exhibit a large centrifugal pump and engines combined, suitable for irrigation or


E.STEINMETZ X.A.

drainage, being the largest pump of the kind which has yet been constructed. (See *Drawing*, p. 7.)

The pump is one of four made for the Graving Docks of the new East and West India Docks at Tilbury, and will discharge 10,000 tons, or 2,240,000 gallons, of water per hour.

The maximum quantity of water that the water companies have power to abstract from the Thames is 110,000,000 gallons per day, or about 4,600,000 gallons per hour, so that two pumps of the size exhibited would be capable of lifting as much water as the Companies can take from the Thames. Ten thousand tons of water an hour are equal to a stream of water 50 feet wide and 1 foot deep, flowing at a velocity of 2 feet per second, and will cover 100 acres to a depth of 1 inch.

The pump is driven by two engines, one at each end of the crank-shaft, the cylinders being 22 inches diameter and 16½ inch stroke. They are fitted with "Joy's valve gear," so as to enable the steam to be used in the most economical manner.

The suction and delivery pipes of the pump are not exhibited, but the sizes may be of interest; they are: suction-pipe, 4 feet in diameter at the pump, enlarging to 7 feet diameter in a length of 9 feet; and delivery-pipe, 44 inches at the pump, increasing to 60 inches in a length of 12 feet.

DESCRIPTION OF THE ILLUMINATED FOUNTAINS.

In the ornamental water in the grounds of the Exhibition fountains of various designs have been arranged, which are illuminated after dark by means of the electric light. The electrical and optical arrangements connected with the illuminations of the fountains have been carried out by Sir Francis Bolton; the jets and fountain arrangements having been executed to his designs by Messrs. Baskervill & Pittman. The telegraphic signalling apparatus has been supplied by Messrs. J. & W. E. Archbutt.

The water supply for the fountains is furnished by the West Middlesex Waterworks Company, under their engineer, Mr. Thomas Hack, C.E.; the pipes for the fountains were constructed from Sir Francis Bolton's designs by Messrs. Simpson & Co., and the water mains laid by Messrs. Lucas & Aird, under the supervision of Mr. Bell, of the West Middlesex Water Company.

The special divers' dresses have been furnished by Messrs. Siebe & Gorman. The Rev. C. Berthon has kindly lent the collapsible boat used in the ornamental water in the grounds.

The following is a description of the means by which the effects shown by the fountains are produced:—

The water for supplying the fountains is delivered direct from the West Middlesex Water Company's Hammersmith reservoir. The main enters the Exhibition grounds from the north-west, and is conducted to the four water-meters, on the western side of the centre basin, which register the quantity of water consumed. From this point a large main leads to the "island" in the centre of the basin, where the principal jets rise. The water is supplied with a pressure of about seventy pounds to the square inch, which is sufficient to carry it to a height of 120 feet.

The wires for supplying the electric light are thoroughly insulated, and are conveyed to the island enclosed in lead pipes to protect the insulation.

The whole of the jets are worked by screw-valves and levers placed inside the island.

The fountain display is directed from the clock tower at the south side of the garden, the "operating-room" being behind the dial of the large clock. The operator controls not only the working of the jets, but also the colour and power of the lights, by a series of electric signals. In front of him is a board with twenty "pushes," which communicate with bells and indicators inside the island. The bell-pushes are labelled "call," "on," "off," and "steady," while the indicator-pushes are marked with the names of different colours and valves.

The illumination of the water-spray, which produces brilliant effects when falling, is effected from the clock-tower.

In the "operating-room" are two "Brush" arcs, of 2000-candle power each. These are assisted by the holophote, containing an arc of 10,000-candle power, which is situated in the room above. It is the holophote that reflects the red, white, and blue colours on the cascade, also the parti-colours on the fountains themselves. The colours are sent through a medium of sheet-gelatine stuck on a glass frame similar to a small window. Several of these frames are fitted on a sliding rack, and are raised into position by pulling a string. On the signal being given, the window in position before the holophote is allowed to drop, and another immediately raised, producing a rapid change of colour. These changes are directed by eight electric indicators and a bell.

Higher still is the outside platform, from which the Hockhausen "mast light" is raised and lowered, and, while the fountains are being illuminated, the scarlet shade, in shape like an inverted umbrella, is drawn up to dim this powerful light.

The attention of the engineer in charge inside the island having first been "called," the "on" bell and the "centre" valve are then touched, and he immediately starts the centre jet, the big fountain. Should a colour bell be rung, a ray of light is seen to illumine the water as it rises from the island. Each signal given from the tower is acknowledged from the island by a reply bell, and notice of intended changes is given to the workers of the holophote above.

The machine-room inside the island is an apartment 21 feet square. Its roof being little over 5 feet from the floor, renders it impossible for the operators to stand upright in it. The floor is crossed and recrossed in all directions by iron pipes, conveying the water from the main to the various jets.

The fountains are set in action by screw-valves fixed vertically on the different branches attached to the water mains. The large jets, which send the water to the greatest heights, are worked by plug-valves and levers, so as to allow an instantaneous start and stop, which causes a shower of spray. There are, altogether, eleven wheels and three levers. The wheels are nearly equidistant round the room, the levers being in the centre.

In the roof are five circular skylights of very strong glass, one of them being exactly in the centre, the others forming a square about it. Under each of these skylights is a wooden stand, on which is fixed a hand arc lamp of 8000-candle power. Over each arc is a lens, which concentrates the light on the jet. When the order "Lights on" is received, the five arcs are set going, the result being to powerfully illumine the jets of water, and produce a glistening effect. The power for the hand-lamps is supplied by a 70-horse power Siemens machine. When the apparatus is about to be set in action, the ventilators, as the narrow side windows are termed, are closed down otherwise the room would be flooded. The usual staff is five—one man to work the valves, three to attend to the lights, and one to watch and reply to the bells. They cannot see what is going on outside, their only means of knowing that all is right being the signals from the clock tower. The quantity of water sent up averages 70,000 gallons an hour, but while all the jets are going at once 1,000 gallons are used in fifteen seconds. The designs to be thrown on the cascade are worked from a lantern placed inside the island facing the treble fall. The water towers at either side of the statue are capable of throwing a stream of water, containing a ray of electric light, into the basin below with a very beautiful effect.

REFERENCES TO PLANS AND LISTS OF EXHIBITS.

I.—KENT WATERWORKS.

Engineer—Mr. W. Morris, M. Inst. C.E.

Plans.

No. 1, in the centre of the sheet, shows the Deptford works. The river Ravensbourne, from which the company formerly took their supply, flows from east to west; on the south side of the stream is an old disused reservoir; at the west end of the reservoir is the old engine-house, built in 1812, which contains a pair of Boulton and Watt's engines now used for the supply of Blackheath; at the opposite end of the reservoir is the garden engine-house, which contains a 60-inch Cornish engine, raising 2,500 gallons per minute from well No. 1.

On the north side of the stream, at the eastern corner of the plan, is the Cold-bath engine-house, which contains a 60-inch Cornish engine, raising 2,000 gallons per minute from well No. 3. Below this, coloured green, is a meadow; the site was formerly occupied by a subsiding reservoir; adjoining this is the twins engine-house, containing two Cornish engines, one raising 2,500 gallons per minute for well No. 2, the other forcing the water raised from the well into the mains supplying New Cross. The part tinted pale yellow indicates the position of two old filter-beds which have been converted into covered reservoirs; there is a third filter-bed not now in use tinted brown. The remaining engine-house contains a pair of 70-inch Cornish engines, which force the water raised from the wells into the mains supplying Deptford and Greenwich. The land to the west is let to a market gardener. The other buildings consist of the company's offices, dwelling-houses, stores, and workshops. Average daily supply from Deptford, 1883, was 4,172,243 gallons.

No. 2 shows the Plumstead works, which consist of engine-house containing a pumping engine and well; there are also three reservoirs, one of which is covered. Average daily supply, 1883, 412,533 gallons.

No. 3 shows the Crayford works; there are three wells and three pumping engines at these works, two of which are working continuously, the third being kept in reserve. Average daily supply, 1883, 2,797,587 gallons.

No. 4 shows the company's works at Shortlands, near Bromley; there are two wells and two pumping engines which are constantly at work for the supply of this part of the district. Average daily supply, 1883, 1,476,400 gallons.

No 5 shows the Dover Road Pumping Station; there is no well at these works; the engine-house contains a pair of horizontal engines, used for pumping the water from Woolwich common reservoir for supply of Shooter's Hill.

No. 6 shows the company's works near Orpington, in the parish of Farnborough. The engine-house is built to contain a pair of Cornish engines, of which one only is erected; it is employed in pumping water from a well for the supply of this part of the company's district. Average daily supply for 1883, 714,730 gallons.

EXHIBITS.

1. Morris' patent elastic band valve.
2. Harvey and West's, double beat valve.
3. 1 inch Kennedy's meter.
4. ½ inch Kennedy's meter in action.
5. 3 inch Manchester meter.
6. 6 inch Siemens' meter.
7. ½ inch Siemens' meter, in section, fitted to a bye-pass pipe.
8. 1 inch Siemens' meter.
9. 3 inch Berlin combined meter.
10. 1 inch Berlin meter
11. 1 inch Union meter.
12. ½ inch Parkinson's low-pressure meter.
13. Drum of Parkinson's low pressure meter in action.
14. Morris's patent tapping apparatus, for making connections with mains under pressure, fixed to 18-inch pipe.
15. Morris's patent tapping apparatus, in section, for making connections with mains under pressure, fixed to 10-inch pipe.
16. ½ inch patent ferrule, in section, for use with Morris's tapping apparatus.
17. ¾ inch Morris's patent ferrule.
18. 1 inch Morris's patent ferrule.
19. ½ in., ¾ in., and 1 in. Morris's patent ferrule, with lead pipes attached and fitted to 6-in. pipe.
20. ½ inch driving ferrule with lead pipe attached.

21. Coburg fitted with ½ inch screw ferrule, used where driving ferrules are removed and replaced by screw ferrules for constant service.

22. ½ inch screw ferrule attached to bye-pass pipe.

23. ½ inch screw ferrule attached to lead pipe with stop-cock.

24. ¾ inch screw ferrule attached to lead pipe.

25. 1 inch screw ferrule attached to lead pipe.

26. ½ inch stop-cock ferrule attached to lead pipe.

Note.—The foregoing seven items are fixed to two pieces of 4-inch pipe.

27. ¾ inch stop-cock ferrule.

28. Tools used by the Company's turncocks and service layers; consisting of turncock's bar key and spoon, pickaxe, shovel, rammer, tool-bag, hammer, two flat chisels, three half-round chisels, brace, rymer, ½ in., ¾ in., and 1 in. taper gas-taps, two spanners, two yarning irons, three caulking irons, screw, wrench, and stop-cock key—making in all 29 articles.

29. 3 inch plug pipe and wood fire-plug.

30. 4 inch plug pipe with frost stand-post.

31. Plug box.

32. 4 inch elbow ball hydrant with fire stand-pipe.

33. 3 inch elbow ball hydrant with lengthening piece for use where the level of the roadway has been raised subsequent to the laying of the pipe.

34. Mode of attaching ball hydrant to ordinary fire-plug pipe in districts placed under constant supply.

35. Hydrant box.

36. 4 inch screw-down fire-cock.

37. 3 inch screw-down fire-cock with frost stand-pipe with section of surface box and brick pit.

38. Stone's "Metropolitan" fire hydrant, as adopted by the Metropolitan Board of Works.

39. Stone's Metropolitan sluice valve in section.

Note.—This sluice valve is placed between two pieces of 4 inch pipe to which are attached various ferrules.

40. Stop-cock box.

41. Crossley's self-registering rain-water gauge.

42. Crossley's self-registering rain-water gauge in action in the grounds.

43. Kennedy's self-closing draw-tap for courts, with cover taken off.

44. Wooden branch pipe with two wooden pipes attached—unearthed in the Greenwich Road on the 9th June, 1884.

45. Glass show case containing :—

Lead pipes twisted by plumbers in screwing up iron pipe.

Defective plumbers' joints.

Laminated lead pipes.

Lead pipes eaten by rats.

Wrought-iron pipes choked with rust.

Wrought-iron pipes corroded by clay soil.

Root of tree found about 14 ft. under ground in excavating for reservoir at Farnborough.

Horn found in excavating at Deptford.

Flints from well at Deptford.

DIAGRAMS AND PHOTOGRAPHS.

Diagram of Farnborough reservoir.

Diagram of water supply.

14 photographs of Company's works.

16 photographs of reservoirs in course of construction, in four frames.

II.—THE NEW RIVER.

Engineer—Mr. J. FRANCIS, M. Inst. C.E.

Consulting Engineer—Mr. JOHN TAYLOR, M. Inst. C.E.

PLANS.

No. 1.—CHADWELL SPRING.—A natural spring arising from the chalk at a distance of about one mile north of Ware. Before the year 1613, when the construction of the New River was completed by Sir Hugh Myddelton, this spring discharged itself into the River Lee, but since the above-mentioned date it has been one of the feeders of the New River.

No. 2.—BROAD MEAD.—A deep chalk well with pumping engine of 16 horse-power.

No. 3.—AMWELL END.—A deep chalk well with pumping engine of 50 horse-power.

No. 4.—AMWELL HILL.—A deep chalk well with pumping engines of 75 horse-power.

No. 5.—AMWELL MARSH.—A deep chalk well with pumping engines of 70 horse-power.

No. 6.—RYE COMMON.—A deep chalk well with pumping engines of 200 horse-power.

No. 7.—HODDESDON.—A deep chalk well with pumping engine of 50 horse-power.

No. 8.—TURNFORD.—A deep chalk well with pumping engines of 150 horse-power.

No. 9.—CHESHUNT.—A deep chalk well with pumping engine of 20 horse-power; and two storage reservoirs having a total area of 18½ acres and a total available capacity of 39 million gallons.

No. 10.—ENFIELD.—A deep chalk well with pumping engines of 170 horse-power.

No. 11.—BETSTILE, SOUTHGATE.—A deep chalk well with pumping engines of 24 horse-power.

No. 12.—HIGHFIELD, EDMONTON.—A deep chalk well with pumping engines of 210 horse-power.

No. 13.—HORNSEY.—Subsiding reservoirs having a joint area of 8 acres and a total available capacity of 8,500,000 gallons, with eight filter-beds having a joint area of 5¼ acres, and pumping engines of 440 horse-power.

No. 14.—GREEN LANES, STOKE NEWINGTON.—Two subsiding reservoirs having a joint area of 42½ acres and a total available capacity of 90 million gallons; nine filter-beds having a joint area of 9 acres; pumping engines of 1,080 horse-power.

No. 15.—HIGHGATE ARCHWAY.—A covered service reservoir having a capacity of three million gallons, with pumping engines of 75 horse-power.

No. 16.—NEW RIVER HEAD, CLERKENWELL.—Subsiding reservoir having an area of three-quarters of an acre; three filter-beds having a joint area of 2¼ acres: pumping engines of 200 horse-power.

EXHIBITS.

Model of the Metropolitan part of the New River Company's district.

Map of the New River Company's district.

Perspective views of the New River Company's Works.

Pictures, drawings, &c., Portrait of Sir Hugh Myddelton—an Engraving A.D. 1632.

Sir Hugh Myddelton's glory—an engraving.

Sir Hugh Myddelton's autograph—1615.

Receipt for water rent—Pepys the Diarist—1701.

New River Head and North London—old engraving.

New River Head—water colour. A.D 1730.

Old London Bridge—showing water-wheels.
Old London Bridge Waterworks Machinery—A.D. 1582.
New River Head—Plan showing leaden mains therefrom.
New Balance Engine.
Section of Ware bore hole.
Rye Common, Engines and Well.

APPARATUS.

Rye Common, Engines.
Hornsey Lane Reservoir (during construction).
Diamond Drill Apparatus.

ANTIQUITIES.

Old wooden pipe.
Pail made out of old wooden pipe from Southampton Row.
Old fashioned flat valve used with wooden pipe.
Section of old leaden pipe.
Old iron pipe—after being 60 years in ground.

PHOTOGRAPHS.

Sections of 12″, 6″, 4″, and pipes with lead joints.
16″ main and sluice valve with 6″ branch and pressure reducing valve.
Sluice valves.
Hydrant—as used in the City of London.
Waterphone.
Turncock's tools.
Tylor's patent waste meter.
Water fittings—bearing New River Company's stamp.

CORES FROM WELLS, AND BORING TOOLS.

Specimens from the chalk, upper green-sand, gault, Devonian and Silurian formations.

22½″	diameter	diamond boring crown.
17½″	,,	core extractor.
10″	,,	auger.
14″	,,	shell.
17½″	,,	chisel.
24″	,,	undercutting chisel.

III.—EAST LONDON WATERWORKS.

Engineer—Mr. W. B. Bryan, M. Inst. C.E.

Plans.

No. 1. Walthamstow.—Eight impounding and storage reservoirs, 220 acres in extent, and of 600,000,000 gallons capacity. Foreman and workmen's houses, deep chalk well and pumps, and turbine of 70 horse-power.

No. 2. Buckhurst Hill.—High service reservoir; level of water line 327·18 feet above Ordnance datum. Capacity 70,000 gallons.

No. 3. Lee Bridge.—The principal pumping and filtering station; area of filters 24¾ acres. Seven pumping engines of 1,050 horse-power. Water wheels, offices, coal stores, workshops, general stores, foreman's house, workmen's cottages, and pipe yard.

No. 4. Woodford.—Covered filtered water reservoirs of 3,000,000 gallons capacity. Two pumping engines of 120 horse-power, foreman's house and workman's cottage, offices and stores.

No. 5. Old Ford.—Pumping station, six pumping engines of 800 horse-power. Covered filtered water reservoir of 3,000,000 gallons capacity, Engineer's residence, grounds, &c. Foreman's house, coal stores, workshops. Survey, district superintendent's and general offices. General stores, landing wharf from Lee, testing houses, pipe yard and stores.

No. 6. Thames Auxiliary Supply, Sunbury.—Intake from Thames. Two pumping engines of 150 horse-power, service tower, foreman's house, coal railway, and landing wharf from Thames.

No. 7. Thames Auxiliary Supply, Hanworth.—Three pumping engines of 600 horse-power. One open reservoir for unfiltered water of 5,000,000 gallons capacity. Two covered filtered water reservoirs of 2,500,000 gallons capacity. Filter-beds of an area of 5 acres. Superintendent's house, offices, stores, coal stores, meter repairing shops, workshops, and pipe yard.

Exhibits.

Old double butterfly valve made for the "Twin" engines, 1807.

Set of old cutters for boring wooden pipes. Cutters about 100 years old.

Old pump bucket from Twin Engines, 1807.

Old air-pump bucket from first Cornish engine erected in London.

Old-fashioned gate valve, about 100 years old, found in March, 1884, in the Mile End Road, attached to a piece of wooden pipe.

Old-fashioned gate valve.

Old-fashioned hydrant.

Hydrant used throughout East London Waterworks Company's district in lieu of wooden plugs.

Pipe and wooden plug.

Three water engines, about 40 years old, intended for positive meters.

Valve made of india-rubber pipe inside iron body.

Indicator to measure variable stroke of Cornish engines, as used by the East London Waterworks Company.

Water engine made by Glenfield Company, used by the East London Waterworks Company to work scrapers of Green economizers and also boiler feed pumps.

Recorder used by the East London Waterworks Company for ascertaining duty done by engines.

Two waste preventers, as used in back courts and alleys in East London.

One 3 Lamberts diaphragm valve.

Double beat valve for East London Waterworks Company's engine " Cornish," being the first engine for waterworks purposes erected in London on the Cornish principle.

" Beehive" valve for "Ajax" Engine, at Old Ford.

METERS.

2″ Walker's " Duplex " meter.

4″ Tylor.

1″ Eureka.

1½″ Stirling's low pressure.

½″ Stirling's low pressure.

3″ Manchester positive meter.

⅜″ Manchester positive meter.

3″ Kennedy positive meter.

⅜″ Kennedy positive meter.

½″, ¾″, 1″ and 2″ Berlin meters by Siemens and Halske.

½″ American meter " Crown."

½″, ¾″, 1″, 2″, 3″, 4″, 6″, 12″ Siemens meters.

½″ positive double-cylinder meter, about 40 years old, maker unknown.

Parkinson's low pressure meter.

1″ Worthington double-cylinder, positive meter, maker unknown.

½″ Pocock meter.

IV.—SOUTHWARK AND VAUXHALL WATER-WORKS.

Engineer—Mr. J. W. Restler, C.E.

Plans.

No. 1 represents the Intakes at Hampton, where the river water passes through cast-iron screens into the reservoirs and filter-beds. At the works situated to the north of the Lower Sunbury Road, the river water is pumped by three direct-acting engines, having a nominal horse-power of 450, through a 36-inch main to the Battersea Works.

No. 2. The Works situated to the south of the Lower Sunbury Road consist of reservoir and filter-beds capable of filtering 9,000,000 gallons per day. The engine power consists of two Cornish beam engines of 420 nominal horse-power, delivering the supply through a 30-inch main to the Company's western district, and also to the Company's service reservoirs at Nunhead.

No. 3. Battersea Works.—At this station the water is received from the Hampton Works No. 1 into reservoirs capable of containing 46,000,000 gallons, it is then passed through the filter-beds, having an area of 11¼ acres, and is pumped into the district by six engines, having a total of 1,200 nominal horse-power.

No. 4. Nunhead Works.—At this station part of the water pumped from the Hampton Works No. 2 is received into covered service reservoirs, having a capacity of 12,000,000 gallons, at an elevation of 150 feet above Ordnance datum. Two engines of 100 nominal horse-power raise a portion of this water to two other reservoirs capable of containing 6,000,000 gallons, and situated at an elevation of 200 feet above Ordnance datum, for the purpose of supplying the higher portions of the district.

Exhibits.

1. Model of house service connection with Bell's patent stop-cock.
    - *a.* Showing section of cock as fixed in place with guard box and false spindle.
    - *b.* Section of cock with cover removed, and water shut back by bottom valve.
    - *c.* Showing self-feeding, drilling, and tapping apparatus for the insertion of ferrule in mains.
2. Bell and Wheatley's patent flushing cistern as used in the Company's district.

3. Hydrant and standpipe as used in constant supply districts.

4. Models of safety balance valves as fixed at the Company's Hampton and Battersea Works.

5. Model of Husband's patent four-beat pump valves.

6. Specimens of strata passed through in sinking the Company's well at Streatham.

7. Old wooden pipes and stop valves taken out in Redcross Street, Southwark, May, 1884; supposed to have been fixed about 70 years ago.

8. Section of standard 4″ double-faced sluice-cock as at present used by the Company.

9. 4″ stop valve taken out from Orange Street, Southwark, 1880, supposed to have been fixed 60 years ago.

10. A $\frac{3}{4}$″ Paine's water meter.

11. Model of patent steam packed piston as used in the Company's engines.

12. Section of $\frac{1}{2}$″ Siemens' water meter.

13. Model of ball and socket joint as used on the Company's 30″ main crossing under the Thames at Richmond.

14. Model of Baker's rotary pump, now being erected for the Company, to lift 16,000,000 gallons 16 feet high in 20 hours.

15. Section of Baker's rotary pump, now being erected for the Company, to lift 16,000,000 gallons 16 feet high in 20 hours.

16. Model showing fire-plug and box as fixed in the Company's district, with standpipe and hose in position as used for extinguishing fires.

17. 60″ delivery valve for 112″ cylinder, 10 feet stroke, with pump plunger, 50 inches diameter, 10 feet stroke, delivering 820 gallons per stroke.

18. 15″ double-faced sluice-cock with gun metal spindle of the Company's standard pattern.

19. 12″ double-faced sluice-cock with gun metal spindle of the Company's standard pattern.

20. 9″ double-faced sluice-cock with gun metal spindle of the Company's standard pattern.

21. 8″ double-faced sluice-cock with gun metal spindle of the Company's standard pattern.

22. 7″ double-faced sluice-cock with gun metal spindle of the Company's standard pattern.

23. 6″ double-faced sluice-cock with gun metal spindle of the Company's standard pattern.

24. 5″ double-faced sluice-cock with gun metal spindle of the Company's standard pattern.

25. 4″ double-faced sluice-cock with gun metal spindle of the Company's standard pattern.

26. 3″ double-faced sluice-cock with gun metal spindle of the Company's standard pattern.

27. 2″ double-faced sluice-cock with gun metal spindle of the Company's standard pattern.

28. Husband's patent four-beat pump-valve for 68-inch pump plunger, 10 feet stroke, delivering 340 gallons per stroke.

29. Model of single-acting Cornish beam engine, showing the type of engine in general use by the Company, manufactured by Messrs. Harvey & Co., Hayle, Cornwall.

30. Model of Lancashire boiler 7′ 0″ diameter, 33′ 0″ long, with Fox and Hopkinson's patent corrugated flue, as recently made for the Company.

31. Model of Galley's patent rocking fire-bars now being tried by the Company.

32. Isometrical view of the Company's Battersea Works
33. ,, ,, Hampton ,,
34. ,, ,, Nunhead ,,
35. Elevation of ,, Battersea ,,
36. ,, ,, Hampton ,,
37. ,, ,, Nunhead ,,

38. Section showing the 30″ flexible pipe laid under the Thames at Richmond.

39. General view of the Company's "collecting system" for underground water at Hampton.

40. Section of filter-bed as used by the Company.

V.—WEST MIDDLESEX WATERWORKS.

Engineer—Mr. THOMAS HACK, M. INST. C.E.

PLANS.

No. 1 represents the INTAKE AT HAMPTON, where the river water passes through fine wire screens, and is pumped by three direct-acting engines, having a total horse-power of 360, through two 36-inch mains to the

No. 2, SUBSIDING RESERVOIRS AT BARNES. Here the water is allowed to subside, and is afterwards passed through sand filters. (A full-sized model showing the construction of these filters may be seen to the right of this plan.) There are four subsiding reservoirs having a total area of 37 acres, and eight filter-beds having a total area of 12 acres, at this station. After filtration the water passes through two 36-inch conduits under the bed of the River Thames to the

No. 3, HAMMERSMITH PUMPING STATION, where there are 6 Cornish engines and 2 compound rotative beam engines, having an aggregate horse-power of 1,335. These engines pump through mains which distribute the water into the district.

No. 4, KENSINGTON RESERVOIR, is a storage reservoir for filtered water on Campden Hill, supplied by the Hammersmith engines, and stands at a height of 124 feet above Ordnance datum.

No. 5, BARROW HILL, is another storage reservoir for filtered water, adjoining Primrose Hill Park, supplied from Hammersmith, at a height of 190 feet above Ordnance datum. The water from this reservoir is further raised by two engines of 90 horse-power to the

No. 6, KIDDERPORE RESERVOIR, in the Finchley Road, 323 feet above Ordnance datum, from which the highest parts of the district are supplied.

EXHIBITS.

Water Pavilion.

Painting in oil of the Works at Hampton.

Painting in oil of the Works at Hammersmith.

Map of district (6″ Ordnance sheet) showing the area supplied by the Company, &c.

Photograph of pumping station at Hammersmith.

Photograph of pumping station at Hampton.

Photograph of pumping station at Barrow Hill.

Isometrical drawings (tinted and coloured) of the Company's several works, viz. :—

No. 1. Hampton.
No. 2. Barnes.
No. 3. Hammersmith.
No. 4. Kensington.
No. 5. Barrow Hill.
No. 6. Kidderpore.

Section of filter-bed (full size), and glass tube supplying water, as delivered by the Company, into a glass basin; also copies of the monthly analysis of the water.

Outer Corridor.

A 33-inch cast-iron socket pipe standing on end.

Specimens of wooden pipes, as used by the Company until 1807 for supplying the water into the district.

Specimens of stone pipes, as used by the Company until 1807 for supplying the water into the district.

A 9-inch reflux valve.

Working model (worked by means of a water-wheel) of one of the Company's 150 H.-P. compound beam engines, erected at the Hammersmith pumping station.

Diagram shewing the consumption of steam per I. H. P. of the above.

Photographs of sand-washing machine, Barnes.
" pumping station, Hammersmith.
" " Hampton.
" " Barrow Hill.

Photographs of storage reservoir and filter works, Barnes.

Water supply fittings, as under.

Section of house fitted up as required under the regulations of the Metropolis Water Act, 1871, by Messrs. John Bolding & Sons, for this and the Grand Junction Company, shewing the most approved method of applying the fittings, and containing—

3 W.-C.'s, with various and approved water-waste preventers;

1 urinal, with various and approved water-waste preventers;

Sink with two draw-off valves, one from the rising main, the other from the cistern;

Bath fitted in conformity to the regulations;

1 case containing approved ball valves, draw-off valves, stop valves, ferrules, and other water supply fittings.

In a pit, showing short length of the Company's service, and the method of connecting the house communication pipe with the service pipe by the stop ferrule.

Screw cocks for mains and services, 2" 3" 4" 5" and 6".

Section of 4" screw cock.

Section of self-acting air valve.

Screw-down air valve.

Short piece of 4" pipe, shewing method of connecting communication pipe to the Company's service pipe previous to 1845.

Short piece of 4″ pipe, shewing method of connecting communication pipe to the Company's service pipe previous to 1871.

Short piece of 4″ pipe, shewing method of connecting communication pipe to the Company's service pipe at present time.

4 approved water-waste preventers.

Ball valves.

Fire hydrants.

VI.—GRAND JUNCTION WATERWORKS.

Engineer—Mr. A. Fraser, M. Inst. C.E.

Plans.

No. 1, Hampton.—This view shows the original intake of the company, through which the water is taken from the Thames into two subsiding reservoirs, and from them is pumped to the Kew Station, 7½ miles distant.

From the same reservoirs the water is supplied to three filters, in which the water is purified, and from which it passes into a covered filtered-water reservoir. The supply to the whole of the Low Level District, extending from Hampton to Notting Hill, is drawn from this reservoir, and is distributed by a pair of rotative engines through an independent line of main pipes.

The large storage reservoir occupies 12 acres of land, and contains 45 million gallons of clear water for use during times of flood in the river.

The new intake at the extreme west end of the ground conveys the water from the river by means of perforated pipes, into the natural beds of gravel and sand in which it is purified, and from which it is pumped up in a clear and brilliant condition, similar to spring water. This is made use of chiefly at times of flood in the Thames.

No. 2, Kew.—This view shows the principal filtering and pumping station of the company. The water which has been pumped from Hampton is received into two storage reservoirs, from which it passes on to 8 filters. From the filters the water runs, after purification, to the engine wells, and is pumped up lofty standpipes, through lines of 30-inch pipes to the company's district east of Notting Hill.

No. 3, Campden Hill.—This is the principal storage station of the company for filtered water. It is kept full by pumping at the Kew Station, and comprises three covered reservoirs, situated 130 feet above Ordnance datum, which contain 18 million gallons of filtered water, and are in connection with pumping machinery capable of supplying the whole of the company's district.

No. 4, Kilburn.—This is the highest reservoir in the company's district for the storage of filtered water; it is situated at an elevation of 250 feet above Ordnance datum, contains 6 million gallons of water, and is covered over.

No. 5, Ealing.—This reservoir contains 3 million gallons of filtered water, and is kept full by pumping at Kew; it is 200 feet above Ordnance datum, and is used principally as a reserve in case of fire in the higher parts of the neighbourhood.

Exhibits.

A. Models.

1. Model of the Kew filtering and pumping station.

2. Model of one of the most recently constructed filters at the Kew Station.

The section of this filter is shown full size, and of the actual materials.

3. Model of the standpipe tower at the Kew Station.

4. Model of the standpipe and chimney tower at the Campden Hill storage and pumping station.

B. Drawings.

1. Plan of all the company's stations on one sheet as they at present exist, drawn to a scale of one chain to an inch, corresponding with the sheet of perspective views.

2. Plan and section of the covered reservoirs at the Campden Hill storage and pumping station.

3. Plan and section of the concrete covered reservoir at the Hampton filtering and pumping station.

4. Plan and section of a sand-washing apparatus, as in use at the filtering stations at Hampton and Kew.

5. Plan and sections to illustrate the method of filtering the river water at Hampton through the natural beds of gravel and sand.

6. Plan of the original works of the company at Paddington, constructed in 1811 by Mr. John Rennie, C.E., for taking water from the Grand Junction Canal.

7. Plan of the company's works at Chelsea, constructed in 1824, from which the river water was pumped to the reservoirs at Paddington, on the abandonment of the supply from the Grand Junction Canal.

8. Plan of the company's works at Kew Bridge, constructed by Mr. William Anderson, a pupil of Mr. John Rennie, in 1835, with the intake laid in the bed of the river, which continued in use down to the year 1852.

9. Section of one of the 70-inch direct-acting Cornish engines, with boilers, at the Campden Hill pumping station.

C. Framed Photographs, Drawings, and Maps.

1. View of the Hampton filtering and pumping station.

2. 3. 4. Do. do. do.

5. Do. New intake for natural filtration.

6. View of one of the filters at the Hampton Station during the process of cleaning, assisted by a movable steam crane.

7. View of the sand-washing apparatus in use.

8. View of the Kew filtering and pumping station.

9. Do.

10. View of the Campden Hill storage and pumping station.

11. View of the standpipe tower at Kew during construction.

12. View of the same when completed.

13. 90-inch cylinder Cornish pumping engine, at the Kew station.

14. View of the covered reservoir at the Campden Hill Station during construction.

15. View of the same.

16. View of the covered reservoir at Kilburn during construction.

17. View of the Kew pumping station, showing the standpipe constructed by Mr. Thomas Wicksteed, taken down when the present tower was erected.

18. 19. 20. Plan and sections of a pair of pumping engines, erected by Messrs. Boulton & Watt at the pumping station at Chelsea in 1824, afterwards removed to the Kew Station, where they are now at work.

21. Plan of works at Chelsea, as designed by Mr. Telford, C.E., 1822.

22. Plan of addition to Paddington works, proposed by Mr. Telford in 1827

23. Sketch plan of Paddington and Chelsea works, with connecting mains, dated 1827.

24. Map of Paddington parish in 1828.

25. Do. 1838.

26. Map of Ealing parish in 1777.

27. Historical map of Ealing, 1822.
28. Map of Shadwell Waterworks in 1794.

D. SPECIMENS AND SAMPLES.

1. Specimen of a wooden water-main, as formerly in use in the London streets, taken up about seven years ago.

2. Specimen of a water-main of pottery with cement joints, recently taken up in Piccadilly.

3. Sample of a plug pipe and wooden fire-plug as in present use.
4. ,, street plug box and cock box.
5. ,, sluice valves as in present use.
6. Samples of meters as in present use.
7. ,, Ince's patent joints for repairing lead pipes.
8. ,, asbestos lubricating oil used in the cylinders of the pumping engines.

9. Samples of asbestos packing for engines, as used in the pumping stations.

10. Samples of Vulcanite used as seating for the pump valves of the rotative engines.

VII.—LAMBETH WATERWORKS.

Engineers—Mr. JOHN TAYLOR, M. Inst. C.E., and
Mr. T. F. PARKES, C.E.

PLANS.

No. 1.—MOLESEY.—The new intake, the store reservoirs for river and spring water of 125 million gallons capacity; the pumping engines of 100 horse-power, and the conduit 4¼ miles long from the river to the Ditton works, capable of conveying thereto 20 million gallons of water per 24 hours.

No. 2.—LONG DITTON.—The principal pumping station and old intake; filters of nearly 8 acres in extent; service reservoir of 3 million gallons capacity; twelve pumping engines of 1,550 horse-power; offices, coal stores, and machinery for landing coal; workshops, general stores, workmen's cottages and other buildings, and general pipe yard. Two cast-iron mains of 30-inch diameter, each 10¼ miles long, to deliver water into the Brixton reservoirs; and the third such main now being laid.

No. 3.—COOMBE, KINGSTON HILL.—Covered reservoir for filtered water of 1,150,000 gallons capacity, pumping mains and turncock's cottage.

No. 4.—Rock Hill.—Covered filtered-water reservoir of 615,000 gallons capacity; cast-iron tank of 100,000 gallons capacity, elevated on a structure of brickwork and roofed over; standpipe to give additional pressure up to 415 feet above Ordnance datum for high service. Turncock's cottage.

No. 5.—Selhurst.—Filtered-water covered reservoir of 2½ million gallons capacity, with spare land for a duplicate. Turncock's cottage, &c.

No. 6.—Streatham.—Two covered reservoirs for filtered water of 7½ million gallons capacity.

No. 7.—Norwood.—Covered filtered-water reservoir of 5 million gallons capacity. Turncock's residence, &c. (A model of this station is exhibited.)

No. 8.—Brixton.—Second lift pumping station, 2 covered reservoirs holding 12 million gallons of filtered water, 12 pumping engines of 930 horse-power; the company's principal offices; coal and general stores, stabling, workmen's residences, and pipe yards. Cost about £140,000 exclusive of land.

Exhibits.

1. District plan.
2. Isometric drawings of the company's works.
3. Coloured sketches of company's works.
4. Plan showing levels of various works.
5. Drawing of floating pipes for drawing off top water from reservoirs.
6. Drawing of section of filter-bed.
7. Diagram showing mode of circulating water in reservoirs.
8. Cartoon diagrams from waste water-meter.
9. Model of district, 1859.
10. Model of Norwood covered reservoir.
11. Mode of connecting communication pipes with company's mains. (Past and present systems.)
12. Section of filtering material.
13. Deacon's waste water-meter in action.
14. Kennedy's meters in action.
15. Reservoir sluice 30-inches diameter.
16. Sluice valves from 3 inches to 30 inches in diameter.
17. Sample of 54-inch diameter pipe, forming portion of conduit from Molesey to Ditton.
18. Road watering posts.
19. Turncock's tools.

20. Specimens of defective pipes and fittings discovered by using Deacon's waste water-meters.

21. Samples of water.

VIII.—CHELSEA WATERWORKS.

Engineer—Mr. Lyn Lea, C.E.

Plans.

No. 1.—Walton and West Molesey.—At this station the water is taken from the River Thames. The "intake" is situated at the north-western corner of the four "subsidence reservoirs" shown on the plan. The water has first to pass through an iron grating (guarded by a movable wooden screen, so arranged as to prevent any accumulation of weeds, leaves, &c., from being drawn down the grating), and then through double screens of fine wire, into the covered wells, from which the water is pumped into the "regulating tank" (a lift of about 20 feet) by two engines, each of 50 horse-power.

From the "regulating tank" the water can be admitted into any one of the four "subsidence reservoirs," where it is allowed to settle, previous to its being sent by gravitation through the 36-inch conduit pipe to the filters at the Surbiton pumping station, a distance of about 5 miles.

The plan also shows the engine and boiler houses, chimney shaft, coal store, workmen's cottages, &c.

No. 2.—Surbiton.—The water is received at the Surbiton Station for filtration through the 36-inch conduit described. The filter-beds are shown adjoining the river, and are seven in number, of which four or five are usually in work at one time, the remainder being cleaned by the removal of the top layer of sand, which is removed, washed and replaced. The water, after passing slowly through the filters, is collected in the engine wells, whence it is pumped up to the covered reservoirs on Putney Heath by 6 engines of 900 collective horse-power, contained in two houses shown on the plan, on the opposite side of the road to the filter-beds. The engine and boiler houses adjoining the filters are used for drainage purposes.

The other buildings shown on the plan are the boiler houses (containing 20 boilers), two chimney shafts (112 feet in height), a coal store, with hydraulic lift and tramway for unloading and hauling the coal, repairing shops, offices and workmen's cottages.

The filtered water is pumped to an elevation of about 180 feet above the engine wells, to the covered reservoirs on Putney Heath, a distance of over 5 miles, through three lines of pipes.

No. 3.—PUTNEY HEATH.—The covered service reservoirs for the supply of the district are situated on Putney Heath, at a level of about 180 feet above the Ordnance datum. These reservoirs are three in number, with a united area of about 5 acres. The two large ones have each a storage capacity of 5 million gallons, the small one a capacity of 1 million gallons. The reservoirs occupy only one-half the area of land shown on the plan, 5 acres remaining available for future extension if necessary. A cottage for the reservoir keeper is shown on the plan.

From the reservoirs the water flows by gravitation into the district, through four lines of main pipes, crossing the Thames at Putney by an aqueduct now in course of removal for the erection of a new bridge, over which the company's pipes will be eventually carried—a temporary aqueduct being meanwhile provided.

EXHIBITS.

A bird's-eye view of part of the works.

A general plan of the whole of the works, and the company's district from Walton-on-Thames to Charing Cross.

An elevation of Putney aqueduct; size of drawing 6 feet by 2.

A framed and glazed drawing of the large pumping engines, &c.; size, 4 feet 6 by 2 feet 6.

A ditto of the smaller engines at West Molesey; size, 4 feet by 2 feet.

2 old maps of Chelsea district, 4 feet by 2 feet, date about 1810.

1 old fashioned (butterfly) valve.

1 ancient fire-plug on a 5-inch pipe.

A Portuguese water-meter.

An old iron water-gauge box.

A modern road-watering hose and fire-hydrant, about 7 feet high.

A section of the high-service reservoir.

An enlargement of the print of old works by Briscoe.

Portrait of the late Mr. Simpson.

The Company's arms in cast iron, dated 1723.

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